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THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA

1113A

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16. Abstract

The investigation demonstrates the effectiveness of ERTS-1 imagery as a means of regularly tracking the freezing and thawing of lakes in central North America, particularly the transition zone separating completely ice-covered lakes to the north from ice-free lakes to the south. The consistent northwest–southeast orientation of the transition zone regardless of season indicates a strong climatic interdependence. A comparison of migration routes exhibited by both the freeze transition zone and atmospheric pressure centers during the autumn of 1972 reveals the following consistencies: (1) polar continental cyclones originate within and/or travel along the trend of the transition zone; (2) polar continental anticyclones fail to cross the transition zone; (3) polar outbreak anticyclones pass through the transition zone unaffected. These consistencies, coupled with a significant intensification of cyclones positioned over the transition zone, suggest that the zone is a major causative factor for the weather in its vicinity. The concomitant influence of regional climate on the freezing and thawing of lakes is shown to be manifest by the integrated average air temperature or running mean temperature (RMT). A comparison of RMT for 18 Canadian weather stations and the movements of the freeze/thaw transition zone during the 1961, 1963, and 1972 ice years confirms that the deep lakes of a region (> 6m mean depth) generally will freeze (thaw) when the 40–day RMT reaches 0°C (4°C), and the shallow lakes (< 6m mean depth) will freeze (thaw) when the 10–day RMT reaches 0°C (4°C). This finding has potential value for estimating the arrival and departure of the transition zone at a given locale or predicting the freezing and thawing dates of lakes with known water mass.

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PREFACE

The primary goal of this investigation was to identify any correlations between the freeze/thaw cycles of lakes and regional weather variations. To meet this objective ERTS-1 imagery of central Canada and north-central United States were examined on a seasonal basis. The ice conditions of certain major ice-survey lakes were noted using standard photo interpretation techniques, the observations recorded on magnetic tape, and base maps used to draw the position of the lake freeze/thaw transition zone. Weather data, as available from the U.S. Weather Service and the Atmospheric Environment Service of Canada were compared with the transition zone migration patterns to determine any correlations.

Comparisons for the 1972 freeze season produced the following correlations:

- Polar continental cyclones originate within and/or travel along the trend of the transition zone.
- Polar continental anticyclones fail to cross the transition zone.
- Polar outbreak anticyclones pass through the transition zone without undergoing any apparent change.

A complementary analysis of various meteorological parameters indicated that storm centers associated with the transition zone underwent significant intensification expressed by a deepening of the pressure trough and increased precipitation outside the zone.

The influence of regional climate on the transition zone was indicated by the consistent northwest-southeast trend of the zone regardless of season, suggesting that latent and sensible heat transfer are the dominant processes controlling both lake freezing and thawing. This conclusion was supported by a comparative study of daily running mean air temperature (RMT) for 18 Canadian weather stations and the movements of the freeze/thaw transition zone. The results demonstrated that transition zone boundaries could be approximated by an appropriate choice of RMT averaging interval. Hence a predictive model was formulated for estimating the arrival and departure of the transition zone:

- Freeze Season - "deep" lakes freeze when the 40-day RMT reaches the freezing temperature (0°C), and "shallow" lakes freeze when the 10-day RMT reaches the freezing temperature;

- Thaw Season - "deep" lakes thaw (breakup) when the 40-day RMT reaches the temperature of maximum water density (4°C), and "shallow" lakes thaw when the 10-day RMT reaches the temperature of maximum water density.

"Deep" and "shallow" lakes are greater than and less than 6 meters in mean depth respectively.

In the strictest sense the results of this investigation are applicable only to the 1972 ice year. Although some corroborative data are available from studies by other investigators, the general applicability of several of the findings remains open to question until confirmed by additional studies.

ACKNOWLEDGEMENTS

The principal investigator would like to recognize the valuable work of John T. Martin who assisted with the preparation of much of the meteorological data used in this investigation, and without whom the interpretive analysis of the ERTS imagery could not have been completed.

The efforts of Fontaine King and Mary Kinsley in the sorting, ordering, and filing of the ERTS imagery are gratefully acknowledged. The Meteorology Branch, NASA/GSFC, is thanked for their cooperation in loaning North American Surface Charts. The Field Meteorological Systems Branch of the Canadian Atmospheric Environment Service supplied historical and ground truth information on the freezing and thawing of many lakes; their assistance is greatly appreciated. The cooperation offered by these and other state, provincial, and federal officials contacted during the course of the investigation was instrumental in the successful conclusion of this work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

C-13

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

SECTION 1.0
INTRODUCTION

This report is a comprehensive review of all work performed under contract number NAS 5-21761 since the inception of the project in May 1972. Only principal highlights of the effort are reported here; supplemental details on various topics can be obtained by consulting previous project reports as referenced throughout this document.

1.1 OBJECTIVES

The principal goal of this investigation was to apply ERTS-1 imagery to the study of the interdependence of lake ice and climate in central North America. This goal is manifest by a number of interrelated objectives:

1. Perform a lake ice survey.

2. Map the migration of the lake transition zone during the course of an ice year.

3. Correlate the transition zone and its movements with regional climatic factors.

4. Develop a technique for predicting the freezing and thawing of lakes.

5. Estimate the mean depths of lakes on the basis of their freezing sequence.

To some extent each of these objectives has been satisfied, although not always with the result that had originally been envisioned [1].

A description of the tasks undertaken to achieve the above objectives and the outcome of those tasks comprises the bulk of this report.

SECTION 2.0
ANALYTICAL PROCEDURE

This section provides a summary of the work performed along with the methods employed to accomplish that work.

2.1 TEST SITE

The test site selected for this investigation comprises the whole of central North America north of 40°N latitude (Figure 1). Included within the site are nine states and five provinces covering a total area of approximately 1.16 million square miles or roughly 13% of the United States and 45% of Canada.

The dotted lines in Figure 1 represent the approximate ground tracks of the ERTS-1 satellite on its descending (or data collection) orbital node. The numbers associated with each ground track identify one day of the satellite's 18-day coverage cycle. As the map indicates, complete coverage of the test site requires the full 18-day cycle.

The test site was chosen not only for its large number of lakes, the exact total of which is unknown, but also for its relatively level topography and low elevation. Hence variations in the freezing and thawing of lakes due to altitudinal or topographic effects are minimized.

Protected by high mountain ranges on the west the site's climate is virtually of a continental variety with hot, dry summers and cold, wet winters. The fairly uniform, predictable climate over most of the study area enabled lake-climate interactions to be interpreted as variances from the general climatic pattern.

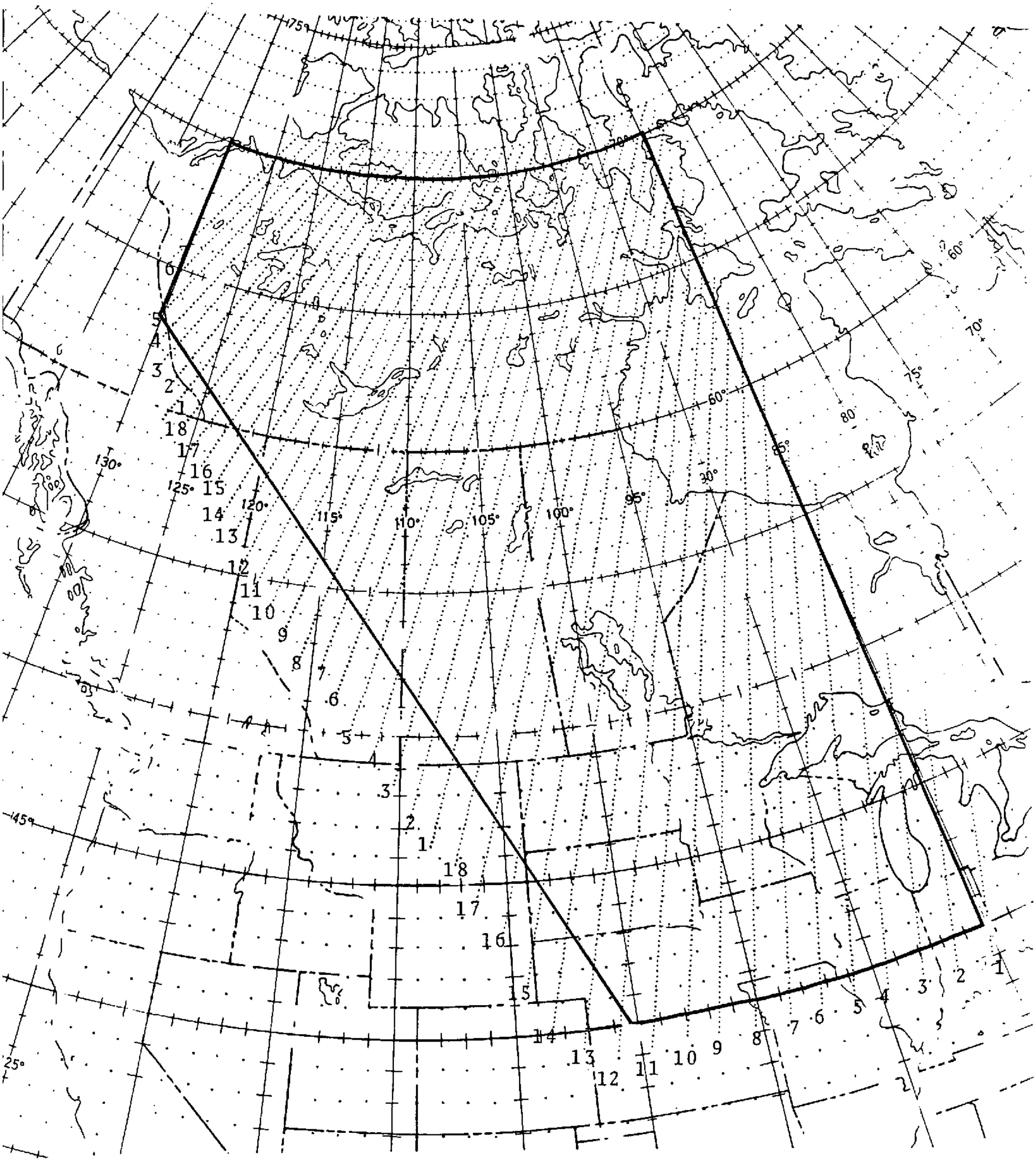

FIGURE 1. LAKE ICE STUDY TEST SITE

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2.2 SURVEY LAKES

2.2.1 Lake Selection

In order to provide the basis for a lake ice survey, an initial task of this project was to identify and select survey lakes. "Survey lakes" are those waterbodies within the test site whose ice conditions were monitored using ERTS-1 imagery. A screening process was adopted whereby all available lakes were tested against either of two criteria:

- Availability of morphometric data,
- Availability of freeze/thaw information.

Morphometric data was defined as surface area, mean depth, and maximum depth, whereas freeze/thaw information was taken to include any historic and/or up-to-date freezing and thawing dates.

A number of potential or candidate survey lakes were found in the open literature [2,3,4,5,6]. In addition, responsible government officials at the state/province and federal levels were contacted for assistance. The Atmospheric Environment Service of Canada was particularly helpful in supplying recent freeze/thaw information from their own rather extensive lake ice survey.

Using the aforementioned criteria as a basis, a total of 411 candidate lakes were identified. Of this number only 65 percent or 268 lakes were finally chosen as survey lakes. In order to be selected each survey lake had to be located and positively identified on base maps consisting of Operational Navigation Charts (ONC), scale 1:1,000,000. This requirement eliminated nearly all lakes with surface areas less than about 2 square kilometers. Inaccurate or nonexistent location data were also a critical factor in the selection process.

The geographical distribution of all candidate and survey lakes is shown in Table 1. As reflected by the table, Wisconsin proved to be the best source of data. Surprisingly, information about the lakes of Michigan and Minnesota was extremely limited. Aside from Wisconsin, few readily accessible sources of limnological information concerning United States lakes seem to exist. On the whole, Canadian lakes are better documented, although here too the availability of information required for this study was limited in relation to the total number of lakes.

As the investigation progressed, more survey lakes were added in order to fill gaps in the geographic coverage of the lake ice survey. Eventually, a total of 357 lakes were included.

2.2.2 Lake Identification Code

Survey lakes were distinguished on the base maps by means of a lake identification code unique to each lake. The code consists of six characters, aabbbc, where aa is state or province reference number, bbb is a lake sequence number for a given state or province, and c is a data descriptor indicating the type of information available for a given lake. The meanings of valid identification symbols are given in Table 2. As an example, consider the identification code 040332. According to Table 2 this study lake is located in Manitoba (MAN) and is the 33rd lake from Manitoba to be catalogued. In addition, the data descriptor code, 2, indicates that both morphometric information and updated freeze/thaw dates are available for lake 040332.

Thus, an identification code number exists for each lake used in the investigation. Note that new lakes may be added by the assignment of a number, and even lakes without

Table 1. Geographical Breakdown of Candidate Lakes and Survey Lakes Selected for use in the Lake Ice Investigation

Country	State/Province	Candidate Lakes	Survey Lakes
CANADA	Northwest Territories	33	22
	Alberta	8	7
	Saskatchewan	52	27
	Manitoba	41	35
	Ontario	24	14
	Sub-Total	158	105
UNITED STATES	Illinois	15	10
	Indiana	6	4
	Iowa	8	4
	Michigan	21	5
	Minnesota	5	3
	Nebraska	31	15
	North Dakota	6	5
	South Dakota	11	11
	Wisconsin	150	106
	Sub-Total	253	163
	TOTAL	411	268

Table 2. Lake Identification Code (aabbbc), Allowable Symbols and Their Definition

Location Code (aa)

Code	State/Province	Symbol
01	Northwest Territories	NWT
02	Alberta	ALB
03	Saskatchewan	SAS
04	Manitoba	MAN
05	Ontario	ONT
06	Illinois	ILL
07	Indiana	IND
08	Iowa	IWA
09	Michigan	MCH
10	Minnesota	MIN
11	Nebraska	NEB
12	North Dakota	NDA
13	South Dakota	SDA
14	Wisconsin	WIS

Sequence Number Code (bbb)

Allowable range: 001-999

Data Descriptor Code (c)

Code	Morphometry	Updated[a] Freeze/Thaw Information	Historic[b] Freeze/Thaw Information
0	-	-	-
1	X	-	-
2	X	X	-
3	X	-	X
4	-	X	-
5	-	-	X

[a]As applied in the code "updated" means including the 1971 ice year.

[b]"Historic" means up to, but not including, the 1971 ice year.

morphometric and/or freeze/thaw data may be included by using the descriptor code 0. Those 357 lakes employed in this investigation as survey lakes are listed in Appendix A along with their identification codes.

2.2.3 Data Base Record

As indicated in a previous section, pre-selected survey lakes were required to meet one of two criteria: (1) their morphometry must be known and/or (2) their freezing and thawing history must be known. The complete data base record of morphometry and icing history on all 268 pre-selected survey lakes is presented in Appendix B. To the author's knowledge this record represents the largest and most comprehensive data set of its type ever collected for North American lakes. Lake Mendota (Wisconsin) has the longest icing history, 107 ice years, beginning in 1852-53. Several other Wisconsin lakes also have long records, but these are exceptional. On the whole the data are spotty at best, and, with the exception of those Canadian lakes for which the Atmospheric Environment Service of Canada makes ice observations, the record is hardly up-to-date.

2.3 METEOROLOGICAL DATA ACQUISITION

Supporting meteorological data were acquired from the following subscription publications:

- Daily Weather Maps (Weekly Series) (U.S.)
- Monthly Climatological Data (U.S.)
- Monthly Record of Meteorological Observations (Canada)

In addition, arrangements were made with the Meteorology Branch, Goddard Space Flight Center, to receive on loan North American Surface Charts (1200Z), published four times daily by the U.S. Department of Commerce. These charts proved invaluable for tracing the movement of air masses across the continent, an essential effort of this investigation to gauge lake ice and climate interdependence.

Surface charts were excellent media for observing highly transient weather patterns on a continental scale, but they were hardly adequate for examining subtle climatological variations at a regional level. For this purpose, a detailed meteorological record was required. To provide such a record, a region of the test site (i.e., Manitoba and western Ontario) was selected, because of the large data volume, and a subset of all weather stations within that region was identified. The 18 stations comprising the subset are displayed in Figure 2. Meteorological data in the form of daily extremes in air temperature were compiled for each station from the "Monthly Record of Meteorological Observations," and loaded into a magnetic tape file. The final data record spanned the ice years 1961, 1963, and 1972, those years for which transition zone observations were available. The application of this data is discussed in a latter section of this report.

2.4 ERTS IMAGERY PROCESSING

The Standing Order for this investigation specified one copy (9.5 in, positive, b/w transparency, each band) of all imagery taken over the test site regardless of cloud cover. Given the size of the test site, this translates into a prodigious quantity of imagery (~20,000 transparencies) over a complete ice year. Obviously, a well-organized handling procedure was required to assure that all imagery were processed quickly and efficiently while avoiding losses due to misplacement.

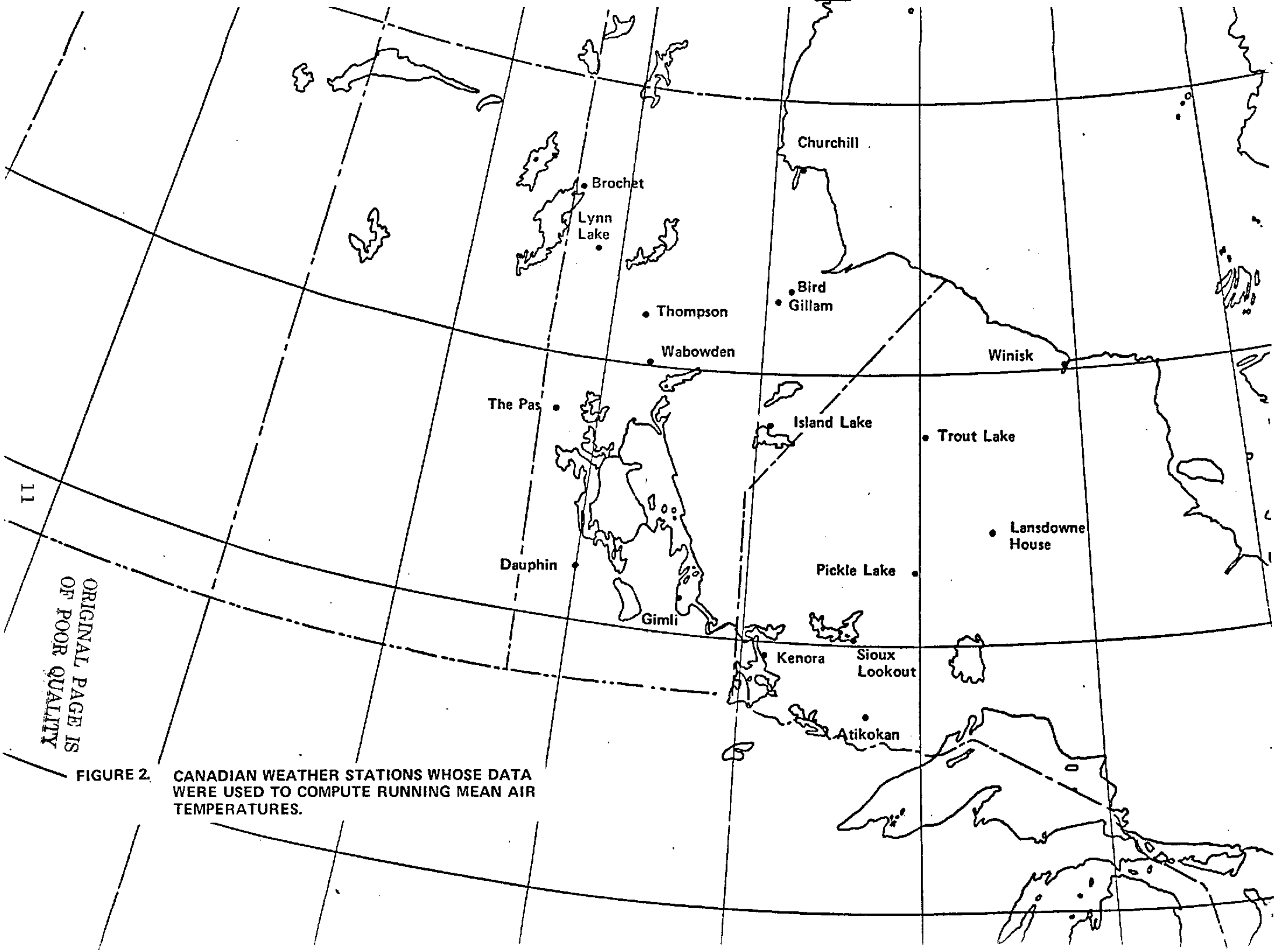

FIGURE 2. CANADIAN WEATHER STATIONS WHOSE DATA WERE USED TO COMPUTE RUNNING MEAN AIR TEMPERATURES.

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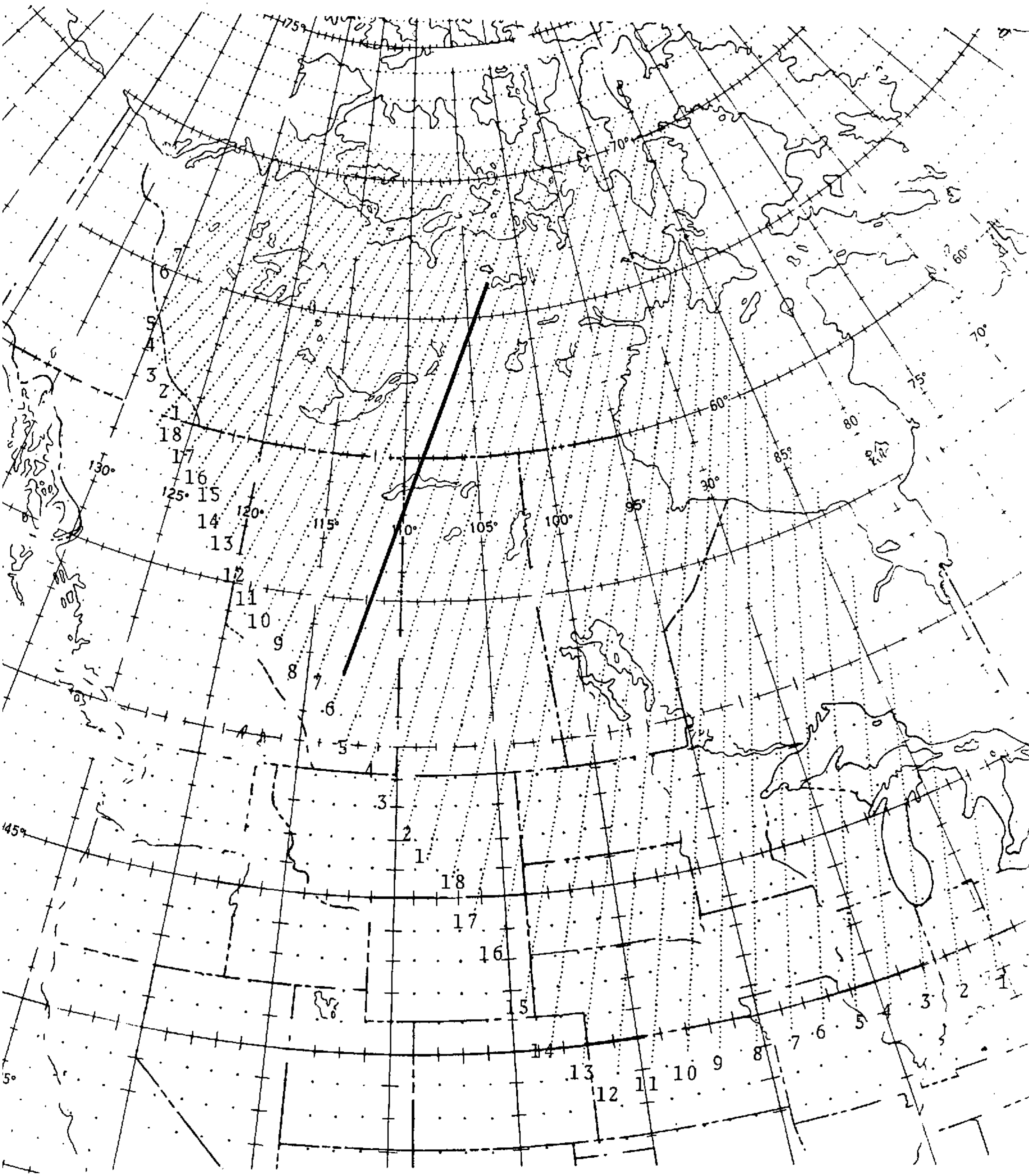
The key to a workable imagery handling system is a simple but accurate procedure for recording the imagery prior to filing. Swath dates can be recorded on an image log, but this supplies no information about areal coverage. For swath coverage a ground track map, such as that shown in Figure 3, was used. As indicated previously, the dotted lines on the map represent approximate ERTS-1 orbital traces, and the numbers indicate orbit days of the 18-day cycle. For this investigation cycle 1, day 1 was arbitrarily chosen as 6 August 1972. As an example of how the map is utilized, suppose a swath of imagery is received for 11 August 1972. The table at the bottom of the map indicates that this date corresponds to orbit day 6 of cycle 1 (see Figure 3). The geographical centerpoints of the first and last scenes of the swath may then be located on the map and plotted on orbit day 6.

The above recording procedure proved to be fast, accurate, and sufficient to meet the needs of this investigation. The system provided an easy means of obtaining a quick inventory of all imagery on file. The entire inventory covered by this report is presented in Appendix C. Those swaths in which ice observations were made are also differentiated.

In order to expedite the extraction of freeze/thaw information from the ERTS-1 imagery, a Lake Observation Data Sheet (LODS) was devised. As Figure 4 shows, the LODS consists of 9 variable fields:

1. DATE. The date on which the scene was taken. (Format: mmddyy, where mm = month; dd = day; yy = year).



ERTS–1 GROUND TRACKS

CYCLE 1 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE AUG	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

FIGURE 3. ERTS–1 GROUND TRACK MAP

LAKE OBSERVATION DATA SHEET

DATE		IMAGE		LAKE NAME	ID CODE	LAT	LONG	S/P		OBS CODE	COMMENTS	
5		10		15 20 25	30 35	40	45			50	55 60 65 70 75	80

FIGURE 4. LAKE OBSERVATION DATA SHEET

2. IMAGE. Image number. For example, if the ERTS image identification number is E-1004-16360-3, the image number would be the last 4 digits of the exposure time or 6360. The image number in conjunction with the date is sufficient to uniquely identify every scene used in this investigation.

3. LAKE NAME. Name of the lake in 16 digits or less.

4. ID CODE. Survey lake identification code in 6 digits or less.

5. LAT. Geographical latitude of lake. (Format: ddmm, where dd = degrees; mm = minutes).

6. LONG. Geographical longitude of lake. (Format: dddmm, where ddd = degrees; mm = minutes).

7. S/P. State/province in which lake is located. (Format: aaa, where aaa = 3 letter state/province abbreviation; see Table 2.)

8. OBS CODE. Lake observation code. Details are provided in Table 3.

9. COMMENTS. Any subjective comments relative to the observation or image in 27 digits or less.

When making a lake freeze/thaw observation from an image, the analyst first located the lake on the annotated ONC maps. This task was relatively easy since the imagery and the maps are approximately equivalent in scale. If the lake was a survey lake, that is, if the map was annotated with the lake identification number, the analyst simply made an entry on the LODS. To be valid this entry need only contain the date, image number, lake ID code, and observation code.

Table 3. Lake Observation Code

FREEZE/THAW CODES

FORMAT: abcc

where a = Cloud Type Indicator

- A: No clouds in vicinity of lake
- C: Cirrus - High level (20,000 feet ice crystals giving the appear-ance of a fine veil. Will be regarded as transparent.
- F: Fog - Very low level coverage; resembles Stratus.
- L: Multiple cloud layers.
- S: Stratus - Solid deck of low level clouds; smooth in appearance.
- Q: Cumulus - Convective, low level clouds; appear puffy

b = Cloud Cover Fraction

- 0-9: Lake free of cloud cover or shadows to lake 90% cloud covered.
- N: Lake completely obscured by clouds; no ice state determination possible.

cc = Ice Cover Percentage

- 00-10: Percentage ice over - To range from lake completely ice free (00) to lake completely ice covered (10).
- blank: No observation.

Should there be no entry on the ONC map, the analyst could create one by assigning a lake identification code, annotating the map, and filling in all information on the LODS exclusive of comments. Realize that any survey lake entering the system in this manner had an identification number ending in 0.

In addition to the above data gathering procedure, which may be described as discrete point observation, the analyst had the option to graphically record his interpretations on a map. This mode of data representation was extremely useful for directly monitoring freeze/thaw transition zone variations in time and space.

2.5 ERTS IMAGERY ANALYSIS

2.5.1 Lake Ice Observation

Straightforward manual photo interpretation was the method chosen for making lake ice observations. A qualitative comparison of 9.5 inch, bulk transparencies and 9.5 inch bulk prints revealed that either imagery format would be adequate for identifying the presence of ice. However, the superior resolution of the transparencies enabled smaller, finer features, such as fracture patterns, to be detected more readily. Consequently, transparencies were used throughout the analysis. Other than a light table and lens, the imagery were interpreted without the aid of special viewing devices, but, owing to the nature of the observation, this was not considered a drawback.

The primary observational objective of this investigation was to identify ice on the surface of any lakes appearing in an ERTS scene. Due to the high reflectivity of ice as opposed to water over that portion of the spectrum covered by the ERTS sensors, an observation of ice state could generally be made without difficulty. Notable exceptions to this statement occurred when highly transparent "new ice" was formed on a lake or when water flooded the surface of partially thawed lake ice. In both of these cases any determination of lake ice condition at the scale of the ERTS imagery was highly suspect.

Any band of the ERTS multispectral scanner (MSS) would suffice for an initial estimation of the presence or absence of lake ice in a given scene. However, for more detailed, lake-by-lake observations one or more bands proved more useful than others. The relative utility of the various MSS spectral bands for detecting lake ice is suggested by the following table:

MSS Band Number	Spectral Range (microns)	Lake Ice Detectability
4	0.5 - 0.6	fair to poor
5	0.6 - 0.7	good to very good
6	0.7 - 0.8	good
7	0.8 - 1.1	good

The "green" band (4) was subject to atmospheric interference such as backscatter, and its signal tended to be attenuated by clouds. The "red" band (5) exhibited fair cloud penetration with proportionally less atmospheric interference. This band could "see" several meters into most natural waters, which occasionally enabled flooded ice surfaces to be discerned. Despite a high reflectivity for ice which often obscured surface features, band 5 was regarded as the optimum band for viewing lake ice. This judgement was corroborated by Barnes [7] from a study of sea ice. The "infrared" bands (6 & 7) were equally useful for lake ice viewing. Band 7 displayed the best cloud penetration of any band, however, the waveband could penetrate only a few millimeters into water.

Consequently, many flooded ice surfaces were undetectable in band 7. On the other hand, the lower reflectance of ice in the infrared enabled many ice features (e.g., fracture patterns, floes, leads) to be noted.

In summary, either band 5 or band 7 would be satisfactory for determining lake ice state during the freezing season. However, during the thawing season when considerable flooding takes place, band 5 is preferred (see Plates 1 and 2).

2.5.2 Survey Lake Observations

During the 1972 freeze season (Aug 24-Dec 16) over 1300 individual ice state observations of major survey lakes were made from ERTS-1 imagery. Almost an identical number were made during the 1973 thaw season (Mar 5-June 30).

Despite the large number of observations in absolute terms, when one considers that there were 357 study lakes, the number of ice state observations per lake over the entire 1972 ice year averaged less than eight. Thus, during the freeze season, for example, the ice state of any given lake could be determined only on about 3-4 different occasions. In reality, these few opportunities are quite reasonable, since the whole ice year was covered in approximately ten 18-day ERTS cycles (Appendix C); the maximum number of viewing opportunities for any lake, allowing for sidelap, would be about 20. Hence, 40 percent of all opportunities to observe survey lakes during the 1972 ice year were successful.

2.5.3 Problems of Analysis

Four problem areas associated with the ERTS system became apparent during the lake ice survey:

- cloud cover
- lake size
- reflectance
- satellite coverage

To a variable extent each problem area hampered the survey.

The question of cloud cover is a fundamental one, since the phenomenon being observed is dynamic and possibly related to enhanced cloudiness. Without doubt opaque cloud cover interfered with observations of lake ice condition. In some cases, when the clouding was of a high altitude, broken cirrus variety, an estimation of ice state was possible, but for the most part clouding resulted in gaps and uncertainties in the observation record. The problem was most acute during the 1972 freeze season, the November of which proved to be the cloudiest on record [8]. Cloud cover was much less extensive and pervasive during the 1973 thaw season.

Due to the resolution limits of ERTS imagery, there was a practical minimum lake size beyond which reliable estimation of surface characteristics by visual means became virtually impossible. This lower bound was estimated at about 2 square kilometers, or approximately the area of identifiable lakes on the ONC charts. Consequently, all lakes smaller than $2km^2$ were effectively eliminated from the lake ice survey. This does not mean to infer that such lakes were undetectable; water bodies only a few acres in size can be distinguished on ERTS imagery [9]. However, detectability of ice cover during the critical freezing or thawing period becomes extremely uncertain for such small lakes.

Natural surface reflectance served as both an aid and deterrent in observing ice conditions. For instance, a partially ice-covered lake was indistinguishable from a sediment-laden, ice-free lake because of their similar reflective properties. Unless the ice was strongly reflecting, as in the case with fresh snow cover, or the ice-water boundary was sharply defined and angular, the ice condition of the lake could not be determined. During the thaw season decaying ice appeared to reflect more strongly in all ERTS bands than freshly formed ice characteristic of the freeze season. This was probably due to the multiple reflecting surfaces of ice crystals in such ice as opposed to the relative transparency of new ice. On the whole, variable reflectance was less of an interpretation problem during the thaw season, although a fair number of uncertain observations were recorded throughout the ice year (see Plates 3 and 4).

A final, critical problem in viewing the ice condition of individual lakes proved to be the timeliness of satellite coverage. The freezing and thawing of lakes, except for the very largest ones (e.g., Great Slave, Manitoba), tend to be highly transient natural phenomena. Ice can appear or disappear from a lake surface in a matter of a few days or, on occasion, in a few hours if meteorological conditions are favorable [10]. With its 18-day repeat cycle ERTS was inadequate as a tool for observing the behavior of lakes during their abbreviated freezing and thawing periods. The satellite was most likely not to be over the right place at the right time. In the absence of ground truth (i.e., field and meteorological data) the freezing and thawing dates of particular lakes cannot be accurately determined solely from ERTS.

2.5.4 Transition Zone Observations

Although individual lake observations did not meet original expectations, transition zone observations largely exceeded those expectations (see Plates 3-5).

ERTS swaths in which the transition zone could be discerned are indicated in Appendix C. A signficant fraction of all available swaths contained useful information about the transition zone. The compilation and interpretation of that information is discussed in the following section.

SECTION 3.0
RESULTS OF INVESTIGATION

3.1 FREEZE SEASON - AUTUMN 1972

The freeze portion of the 1972 ice year required approximately 100 days (i.e., early September to early December). During that time the ERTS-1 covered the test site in five 18-day cycles. For the first time the behavior of the lake freeze transition zone could be documented over extensive spans of space and time.

3.1.1 Transition Zone Migration

A great deal of the incentive for this study resulted from an aerial lake ice survey by Ragotzkie and McFadden [11]. One of the principal results of that work was the verification of a transition zone (TZ), called the lake freezing zone, south of which all lakes are open (ice-free) and north of which all lakes are closed (frozen over). The lake freezing zone reflects the role morphometric factors play in the freezing of lakes. Shallow lakes have less heat to give up to the atmosphere in comparison with deep lakes. Therefore, shallow lakes respond more readily to weather perturbations and freeze over sooner than deep lakes. As a result, Ragotzkie and McFadden referred to the northern boundary of the transition zone as the "deep lake freeze line" and the southern boundary as the "shallow lake freeze line." For purposes of this report, however, the two boundaries will be called, simply, the northern transition zone boundary (NTZ) and the southern transition zone boundary (STZ) respectively.

Observations of the transition zone by ERTS-1 during the month of October 1972 are summarized in Figure 5. The early October TZ (A, Figure 5) exhibited a complexity not obvious in subsequent observations. Although the NTZ lay about 75 km to the south, a small area of lakes just to the southeast of Bathurst Inlet was completely ice free. This anomalous lake group apparently freezes later than other lakes in the vicinity; the cause may be due to the moderating influence of unfrozen saltwater Bathurst Inlet.

The influence of a large, open water body was also evident near Great Slave Lake. Early October weather records show that stations on or near the lakeshore had minimum temperatures ranging 3 to 10°F higher than another station at the same latitude about 100 miles to the west. The ERTS imagery agreed with these data by showing a large area of open lakes in the pocket formed by North Arm and MacLeod Bay, whereas all lakes immediately west of Great Slave were frozen over.

By October 18 (B, Figure 5) the NTZ had moved about 480 km to the south, implying a migration rate of almost 100 km/day, assuming, of course, that the transition zone boundaries are longitudinally invariant. Such an assumption is not justifiable; this point will be discussed more fully in a subsequent section.

Only the STZ was visible on the mid-October imagery (C, Figure 5), and even this boundary was very uncertain due to the considerable cloud cover. However, the interpretation was included because this represented the only TZ observation from the extreme eastern portion of the test site for the month of October.

Although November 1972 has been characterized as the cloudiest November on record [8], the transition zone was visible on three separate occasions (Figure 6).

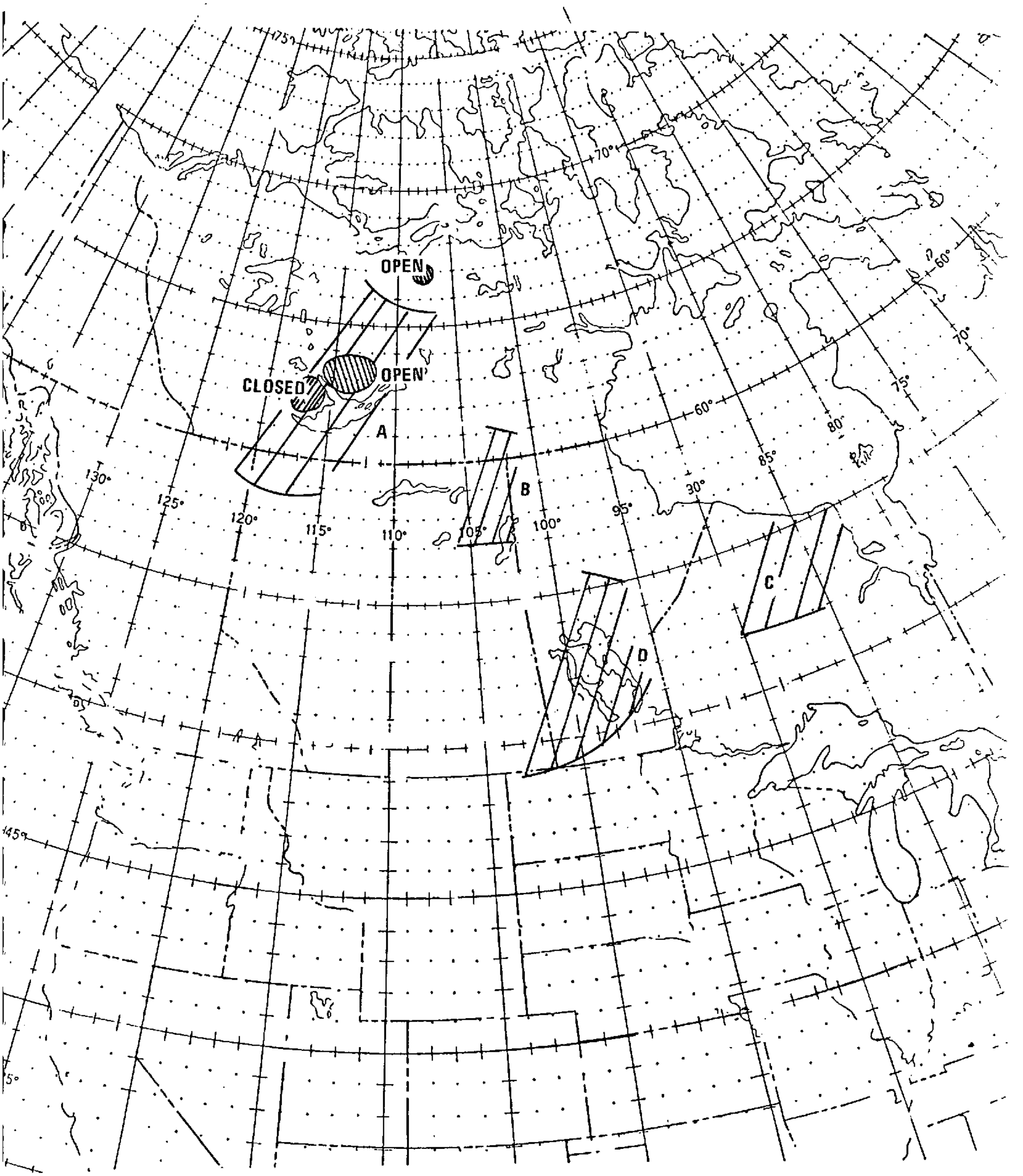


FIGURE 5. LAKE FREEZE TRANSITION ZONE BOUNDARIES FOR OCTOBER 1972

A. 07 OCT 72 – 13 OCT 72
B. 18 OCT 72
C. 22 OCT 72 – 23 OCT 72
D. 28 OCT 72 – 01 NOV 72

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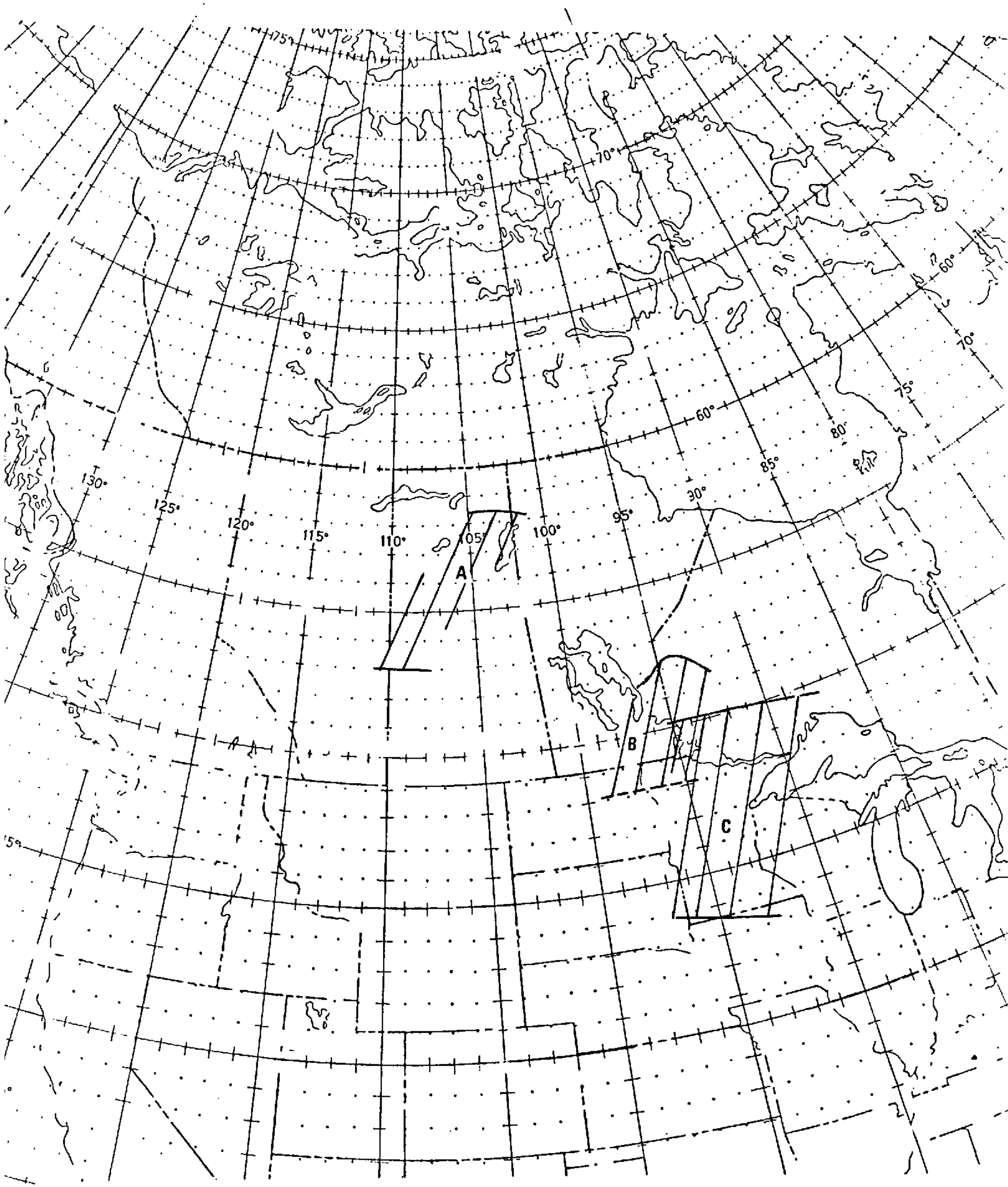

FIGURE 6. LAKE FREEZE TRANSITION ZONE BOUNDARIES FOR NOVEMBER 1972.

A. 05 NOV 72 – 06 NOV 72
B. 13 NOV 72 – 15 NOV 72
C. 28 NOV 72 – 01 DEC 72

The early November TZ (A, Figure 6) represented a marked discontinuity in the southward moving trend prevalent throughout October. In this case the NTZ was located just north of Reindeer Lake or roughly 350 km north of the previously sighted TZ position. Since this was not a period of above normal temperatures, the obvious conclusion must be that the transition zone varied latitudinally as a function of longitude.

By late November the TZ had extended well south into the United States (C, Figure 6), although the NTZ had migrated only about 200 km since the previous sighting. A migration rate of only 15 km/day is inferred from this observation. This value is probably realistic since it was derived from overlapping transition zones. The late November imagery represent the longest, most continuous, cloud-free view of the transition zone for the entire freeze season.

The first of December 1972 marked the beginning of a 14 day cold period during which the daily average temperature was consistently below zero in the TZ area. Weather stations in north-central United States and south-central Canada recorded their lowest temperature readings ever for this period [8]. The intense cold was sufficient to effectively obliterate the transition zone. Observations during the month of December revealed a small number of open lakes and reservoirs scattered over the United States portion of the test site, but these were assumed anomalous.

3.1.2 Comparison With Ground Truth

Due to the size of the test site and the logistics involved, a ground truth support program was not instituted for this study. However, the exact freeze dates of numerous Canadian lakes were acquired from the Field Meteorological Systems Branch, Atmospheric Environment Service of Canada. These dates were more than adequate for checking against transition zone observations.

The freeze dates of the ground truth lakes are superposed on the ERTS-derived transition zone locations in Figures 7 and 8. If transition zones are located properly, freeze dates north of the zone should precede the period of observation, whereas freeze dates south of the zone should post-date the observation period. An examination of Figures 7 and 8 reveals that the above criteria are satisfied in every case except two.

The first exception is Meadow Lake (030454) (Figure 7) whose October 8 freeze date was 12 days earlier than the previous recorded early freeze for this lake. A possibility exists that the Meadow Lake freeze date was incorrectly reported. The other exception is Island Lake (040414) (Figure 8) with a November 15 freeze date. This date was 12 days earlier than the lake's only other recorded freeze date, but the annual variation in freezing times can often exceed that amount. In this case the freeze date and imagery interpretation may both have been correct. This is because the satellite pass (Appendix C) on which both Island Lake and the transition zone were recorded took place on November 15, Island Lake's freeze date. Hence, on November 15 the transition zone could well have migrated south of Island Lake, as the interpretation indicates.

Other than the minor exceptions just discussed, the agreement between transition zone positions, determined solely from ERTS imagery, and lake freeze dates, based on ground observations, is excellent.

3.1.3 Comparison with Previous Studies

The only work comparable to this investigation was that of Ragotzkie and McFadden [11]. Many of the findings of this earlier study were combined into a later, more comprehensive report by McFadden [12]. The combined work contained observational data from two ice years, 1961 and 1963. Since the

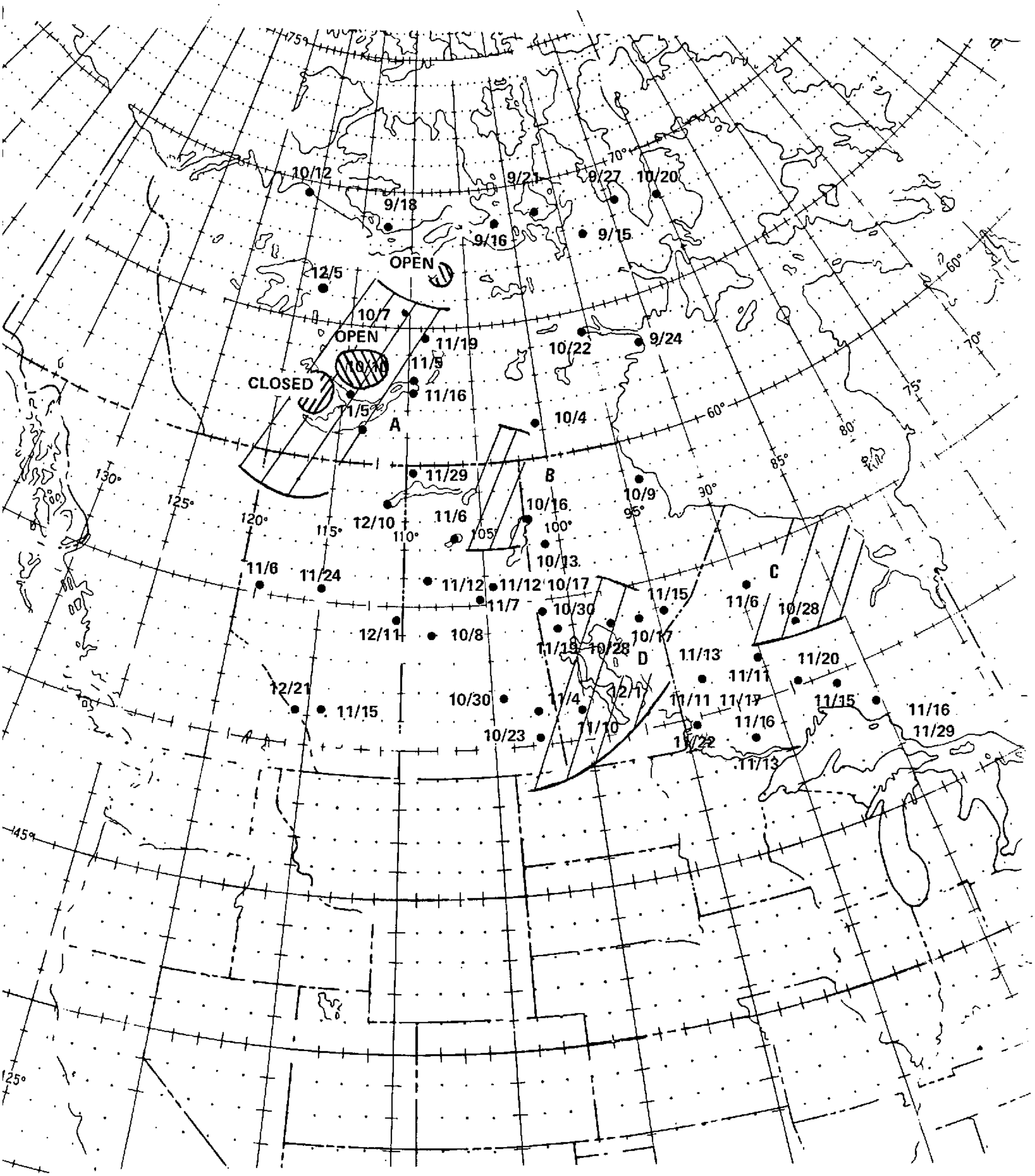

FIGURE 7. GROUND OBSERVED LAKE FREEZING DATES AND TRANSITION ZONE POSITIONS FOR OCTOBER 1972.

A. 07 OCT 72 – 13 OCT 72
B. 18 OCT 72
C. 22 OCT 72 – 23 OCT 72
D. 28 OCT 72 – 01 NOV 72

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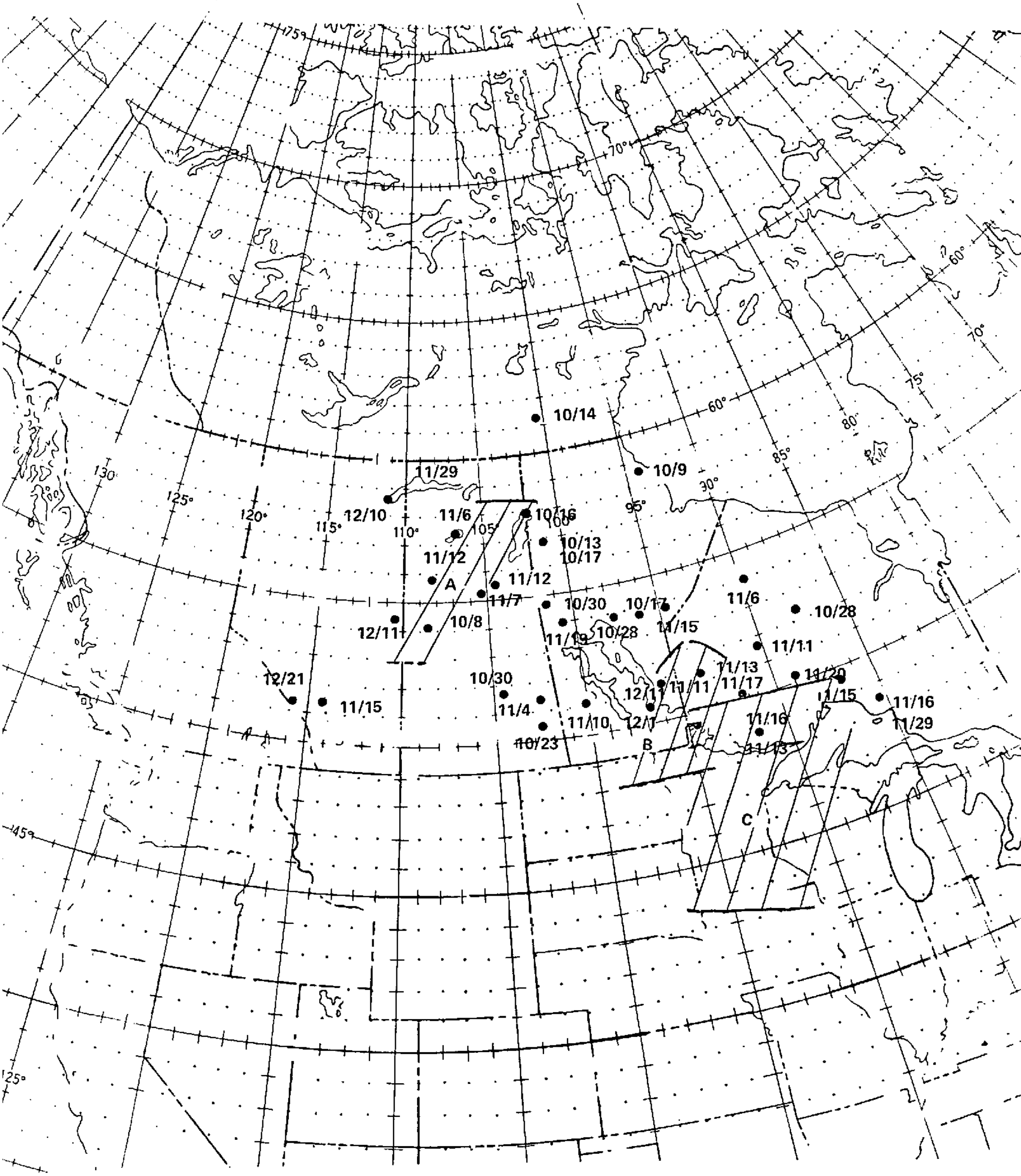

FIGURE 8. GROUND OBSERVED LAKE FREEZING DATES AND TRANSITION ZONE POSITIONS FOR NOVEMBER 1972.

A. 05 NOV – 06 NOV 72
B. 13 NOV – 15 NOV 72
C. 28 NOV – 01 DEC 72

TZ mapped by McFadden during these years lay within the designated test site for this study, similar data sets from each study were compared.

During 1961, Ragotzkie and McFadden were able to observe the transition zone on three separate occasions: (1) October 24-26, (2) November 3-5, and (3) November 7-10. The positions of the zone on the first two of these occasions are shown in Figure 9, along with positions determined by this investigation at comparable times during the freeze season. Considerable overlap exists between McFadden's zones labeled 1 and 2 and that labeled B from this study, suggesting that 1961 and 1972 had quite similar freeze seasons.

A rather different situation prevailed in 1963 with which the 1972 comparisons for October are made in Figure 10 and for November in Figure 11. Both of these figures show that at similar times the TZ remained farther north in 1963 than in 1972. This discrepancy is particularly striking for the October 18 data. Whereas the 1961 and 1972 freeze seasons experienced equivalent weather (i.e., mean monthly temperature for October: 4-8°F below normal), the 1963 freeze season experienced appreciably warmer weather at equivalent times (i.e., mean monthly temperature for October: 4-10°F above normal).

Despite the large difference in October mean air temperature between 1963 and 1972 (i.e., 8-18°F), the transition zones for those two years differed by only 2-3 degrees of latitude (Figure 10). These results suggest that the freezing of lakes is relatively insensitive to short-term (< 1 month) climatic variations.

The comparative results also indicate a longitudinal dependence of TZ position as well as the obvious latitudinal one. McFadden's observations and those made during this study (Figures 9-11) exhibit a definite northwesterly trend

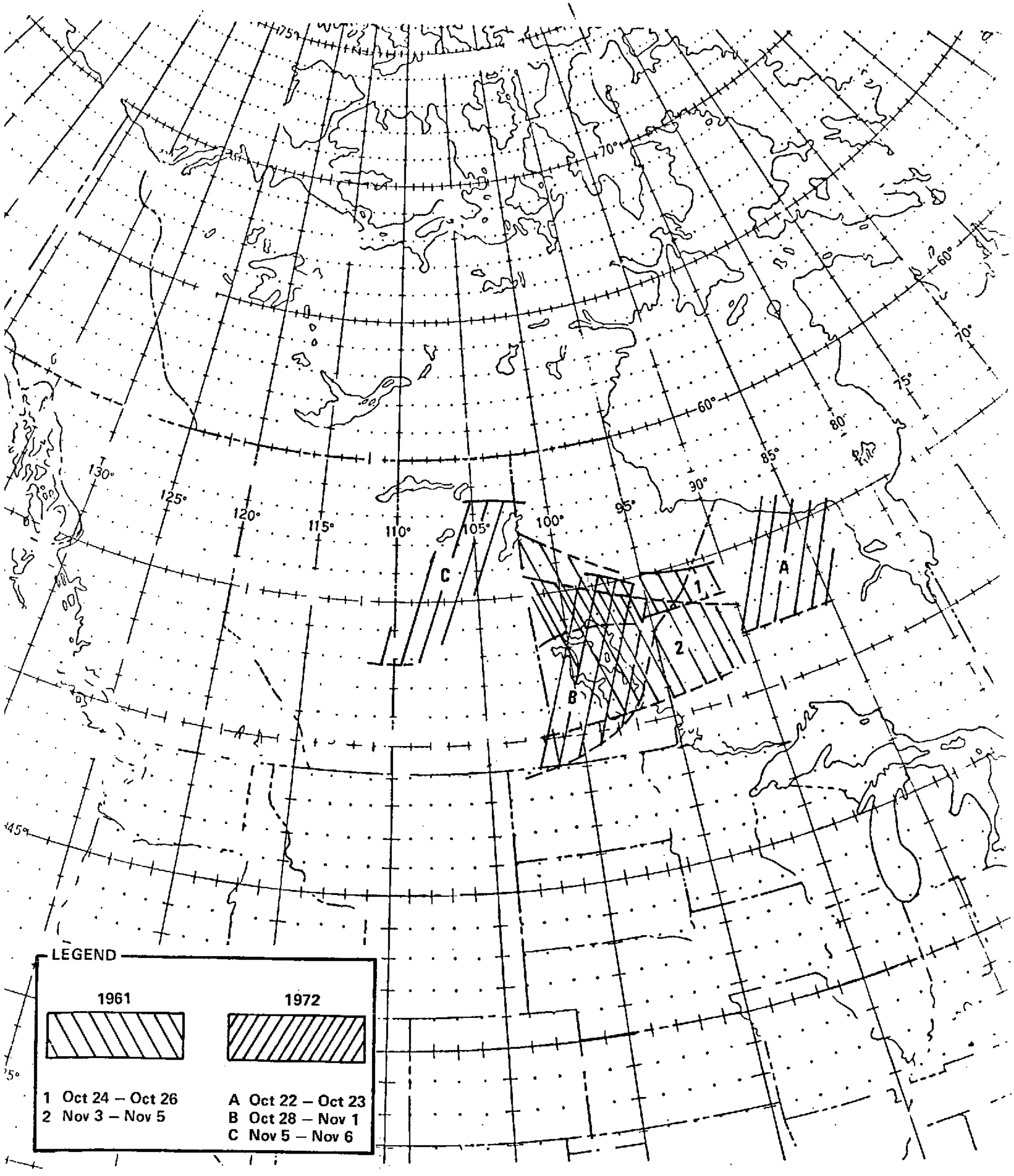

FIGURE 9. COMPARISON OF TRANSITION ZONE OBSERVATIONS MADE IN 1961 (REFS. 11,12) AND 1972 (THIS STUDY)

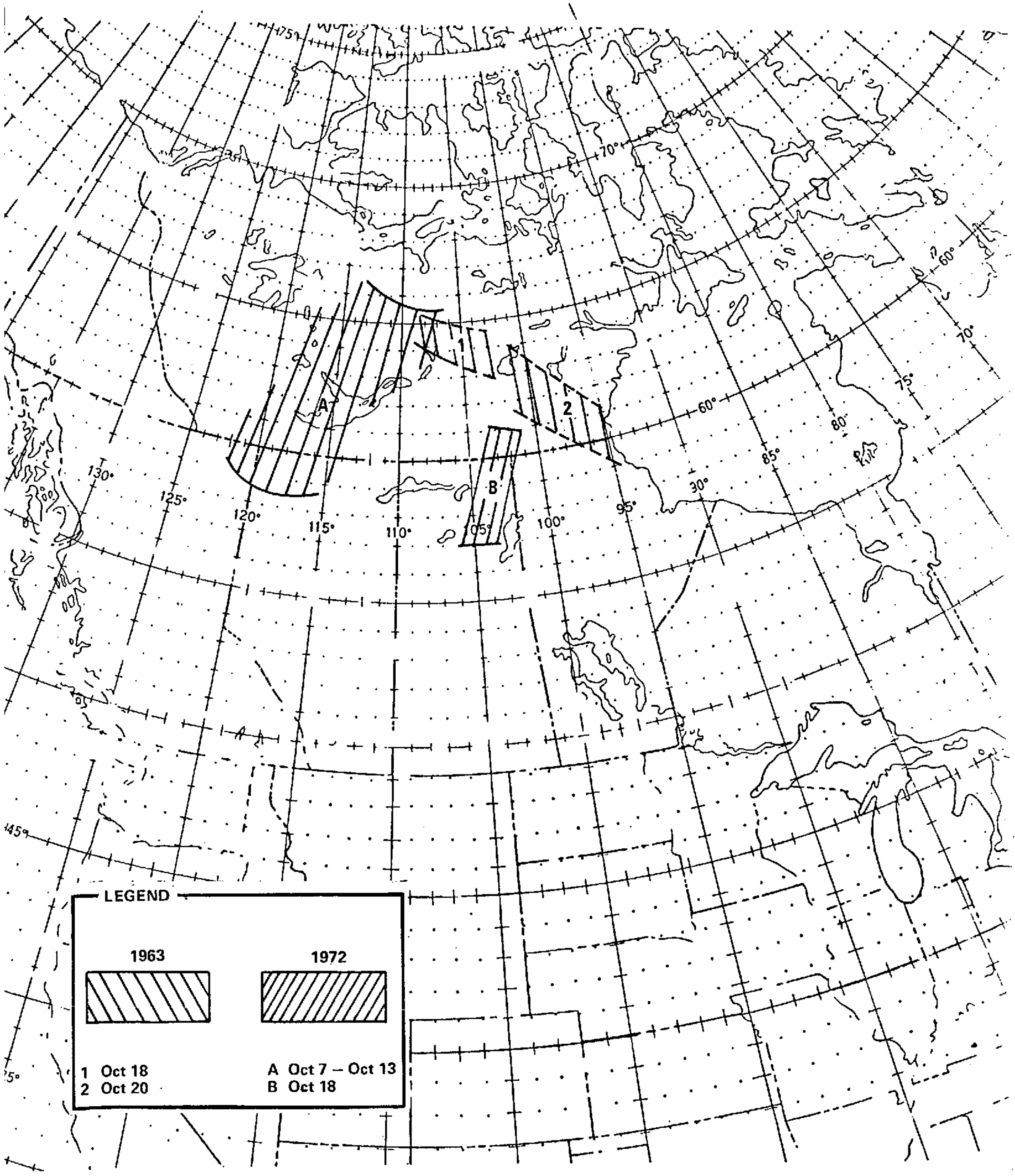

FIGURE 10. COMPARISON OF OCTOBER TRANSITION ZONE OBSERVATIONS MADE IN 1963 (REF. 12) AND 1972 (THIS STUDY).

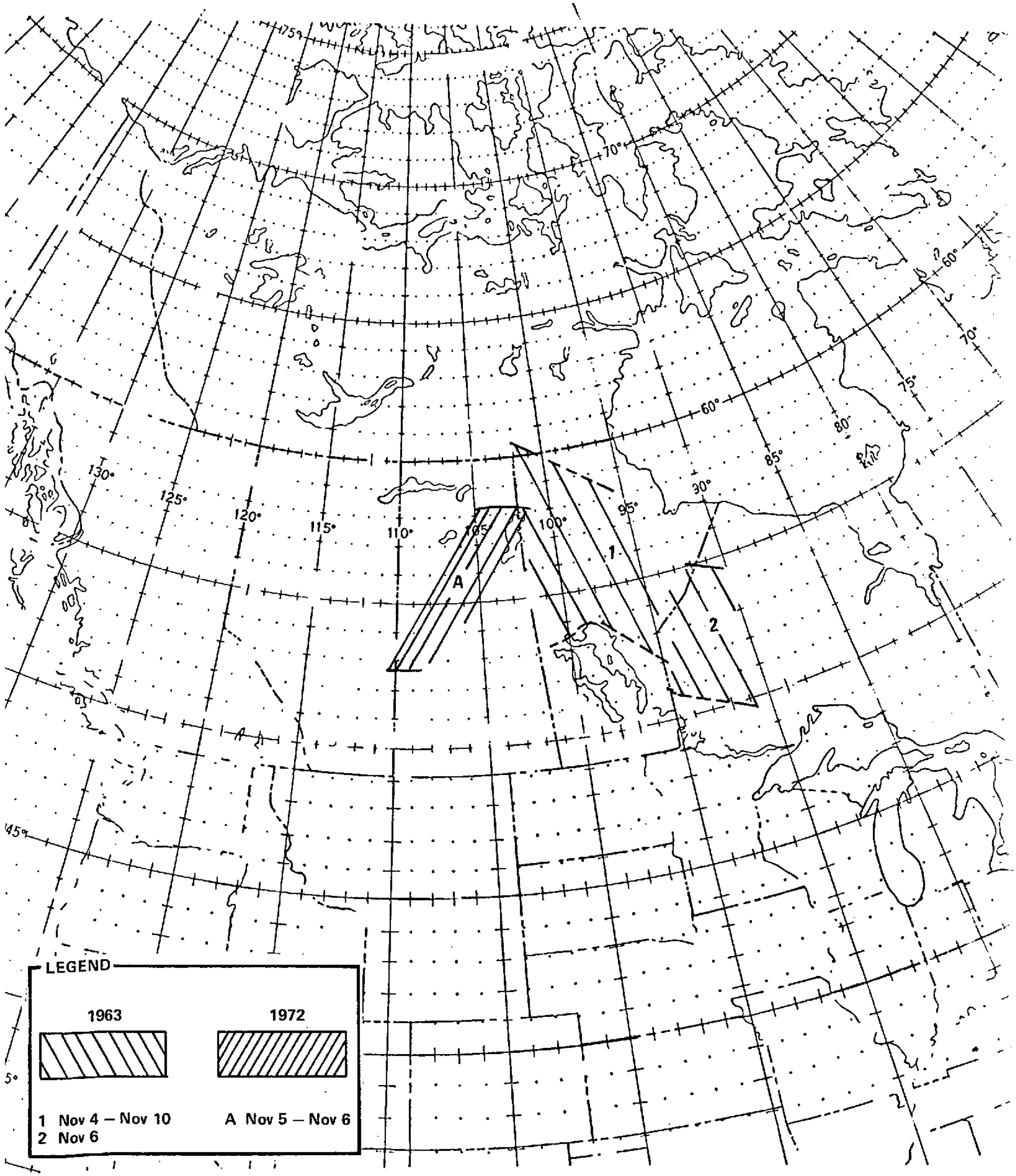

FIGURE 11. COMPARISON OF NOVEMBER TRANSITION ZONE OBSERVATIONS MADE IN 1963 (REF. 12) AND 1972 (THIS STUDY)

for the transition zone in general and the NTZ in particular. This trend breaks down only for the region south of Lake Manitoba. The northwestern direction for the NTZ was readily apparent from the ERTS imagery even though satellite coverage shifts westward on a daily basis, and continued freezing would tend to move the NTZ southward.

The unidirectional orientation of the transition zone over much of the continent can only be attributed to the prevailing autumn climate of the region. This orientation agrees with the general trend of weather systems during the autumn months (see next section). Similarly, the tree line follows the same northwest-southeast bearing. The fact that both of these phenomena independently exhibit the same orientation lends credence to the proposition that general climatology rather than latitude controls the overall trend of the transition zone, and temporal perturbations on that climatology are responsible for any variations in the migratory behavior of the zone.

3.1.4 Comparison With Weather Systems

As stated previously, a primary objective of this investigation was to identify any correlations between the freeze/thaw cycles of lakes and regional weather variations. The ultimate goal of such an effort would be to establish, verify, and explain any interrelationships which may exist. Consequently, a major effort was made to compare the transition zone as observed from ERTS imagery with both local and regional weather data.

Cyclonic and anticyclonic activity was examined in detail for the month of October 1972 using North American Surface Charts (1200Z GMT) compiled by the U.S. Weather Service. The daily position of each pressure center was marked on a base map over a period of several days, enabling the temporal variation of each weather system to be defined. Migration patterns for the period October 6 through October 15 are shown in Figure 12; the observed position of the TZ for that period is also shown. Nearly all pressure centers exhibit the general northwest to southeast motion over the test site that is typical for the time of year. Cyclonic activity predominated in the northern portion of the test site for the first half of the month. Although a polar continental (pC) high did form in Alaska on October 8, the system adopted a southerly heading and skirted the lakes region of central Canada. During the period the transition zone, especially in the vicinity of Great Slave Lake, appeared to act as a source area or area of intensification for upper latitude cyclones (Figure 12).

The motion of weather systems for the period October 15 through October 18 is displayed in Figure 13. This short period was dominated by an intense polar-outbreak high which moved southward across central Canada bringing very cold temperatures to the test site.

A return to more typical pressure center migration patterns is shown in Figure 14 which covers the period October 18 through October 24. During this time, apparently no major weather system traversed the transition zone, although a large pC high followed a path closely paralleling the estimated NTZ for the period.

The end of October (October 24-November 1) was meteorologically complex (Figure 15). Every major pressure system displayed an abrupt shift in its direction of motion from southeast to southwest before resuming a normal migration pattern. During the period another pC high paralleled the NTZ, but seemingly the pressure center always remained north of the transition zone (Figure 15). On the other hand, an upper latitude cyclone passed through the zone in the same fashion as similar cyclones had earlier in the month (Figure 12).

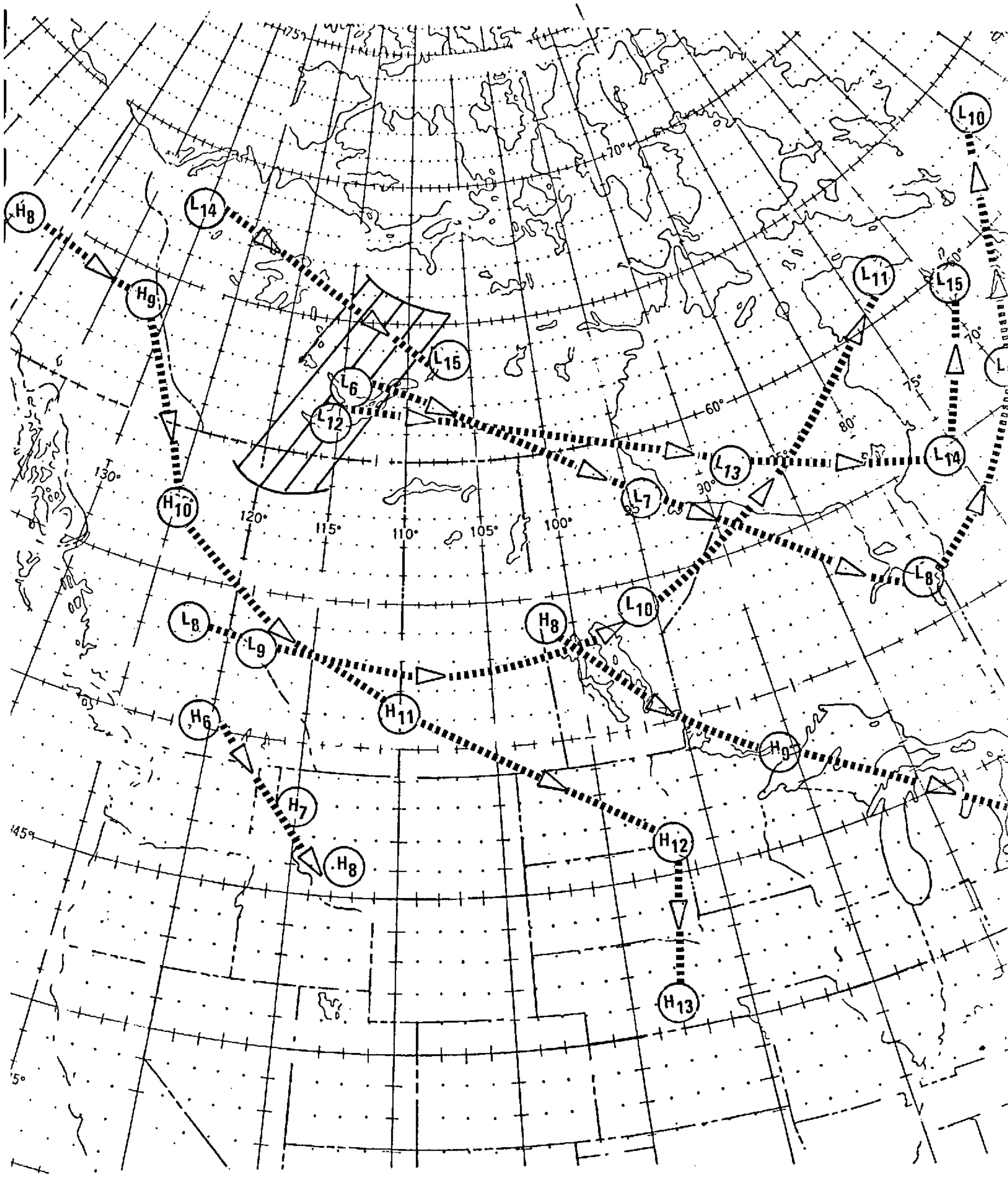

FIGURE 12. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 06 OCT 72 AND 15 OCT 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

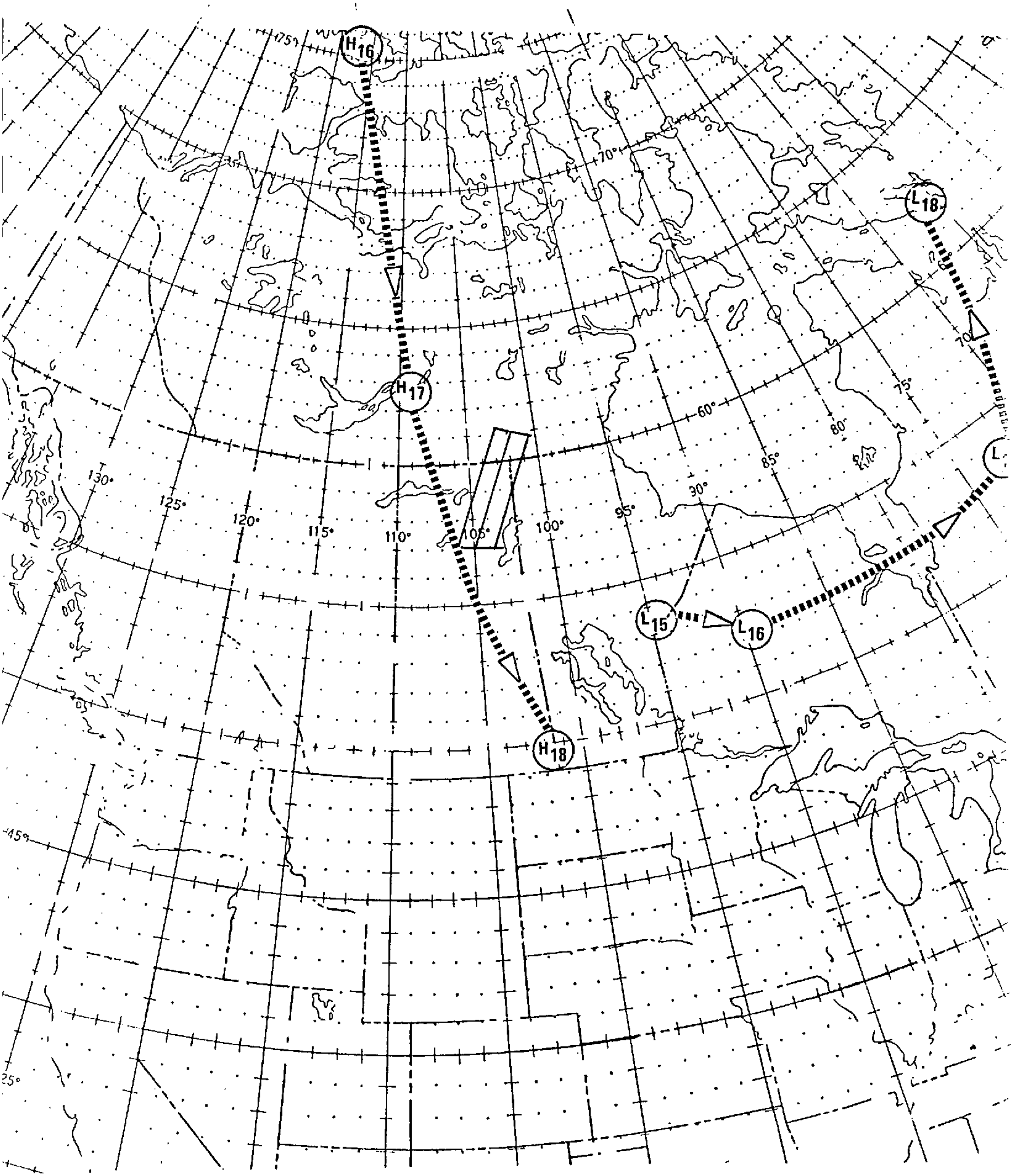

FIGURE 13. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 15 OCT 72 AND 18 OCT 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

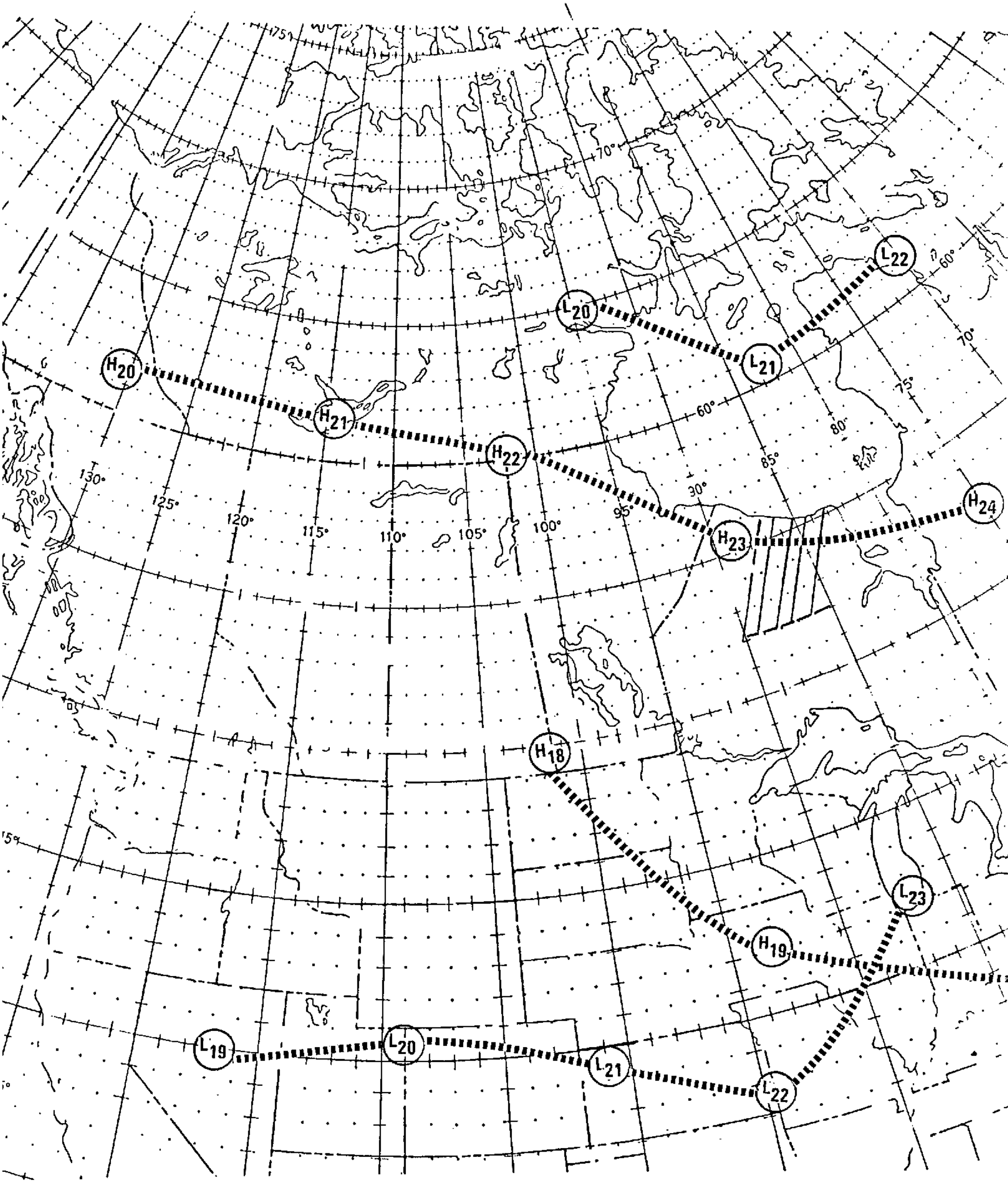

FIGURE 14. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 18 OCT 72 AND 24 OCT 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

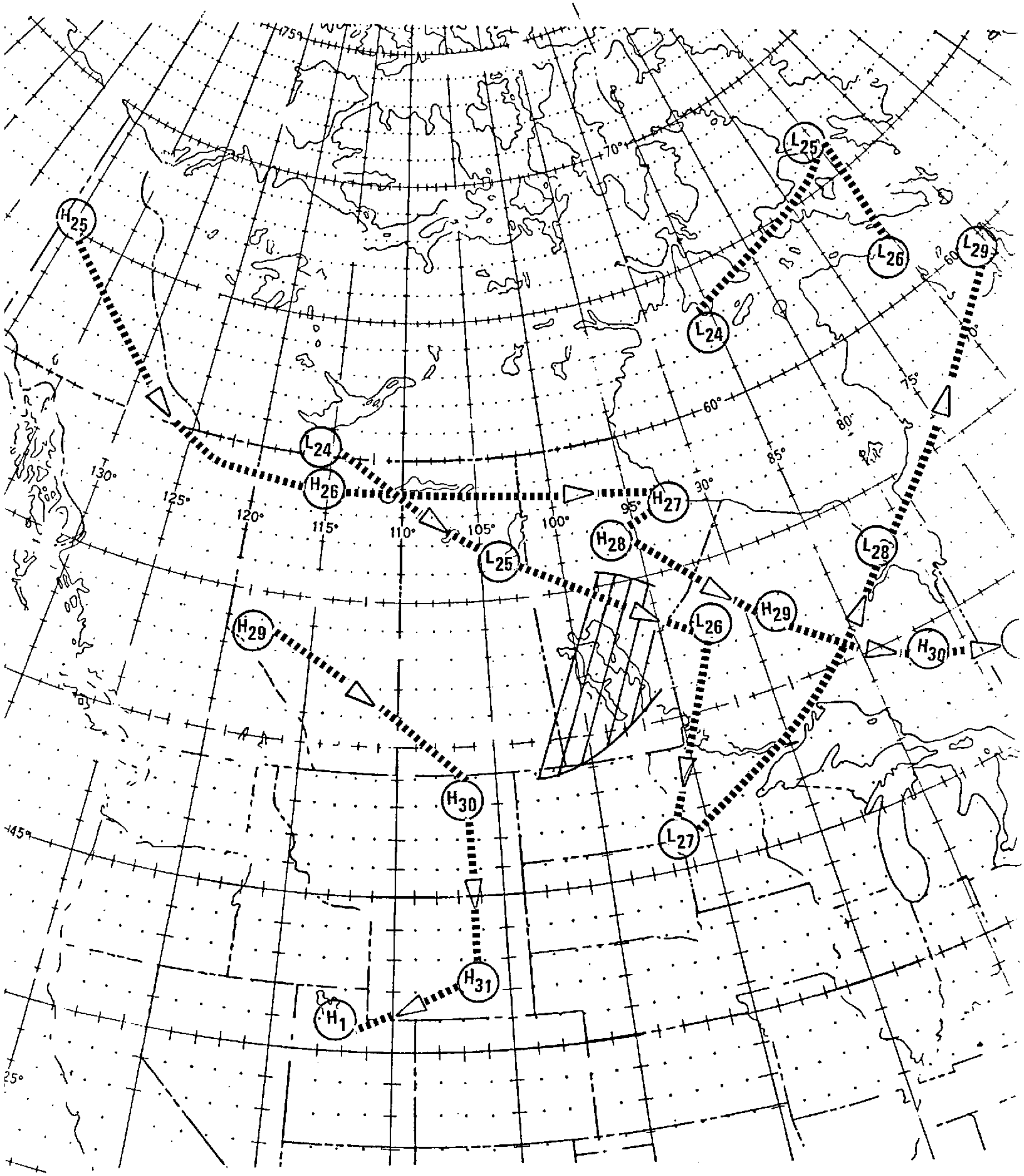

FIGURE 15. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 24 OCT 72 AND 01 NOV 72.
(H=High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

The motion of pressure centers within the study area for the period October 31 through November 4 is depicted in Figure 16. A polar continental anticyclone passed north of the transition zone, the pressure center having moved along the northern transition zone boundary.

The period November 10 through November 18 shown in Figure 17 represents a more complex situation. During this time an anticyclonic system moved obliquely across the transition zone, but the movement was sporadic and irregular. There remains some question as to the type of anticyclone represented since weather data for the week prior to November 10 were missing. Doubtless a polar continental anticyclone did cross central Canada on November 15-16 (Figure 17). However, this system moved through southern Alberta and Saskatchewan, well to the west of areas characterized by large populations of lakes.

The final case for comparison covers the period November 23 through December 6 (Figure 18). During this period the transition zone ceased to exist as a well defined region of frozen-unfrozen lakes and became instead scattered clusters of open or partly open lakes surrounded by completely frozen lakes. The rapid breakdown of the transition zone can probably be attributed to the exceptionally cold temperatures that characterized this particular time. The weather systems traced in Figure 18 are characteristic of extreme conditions, especially the very large polar cyclone centered over Hudson Bay. This system brought the coldest temperatures for November to south-central Canada and north-central United States [8].

The comparison between the freeze transition zone as determined from ERTS and the movement of pressure centers (Figures 12-18) has produced some remarkable consistencies:

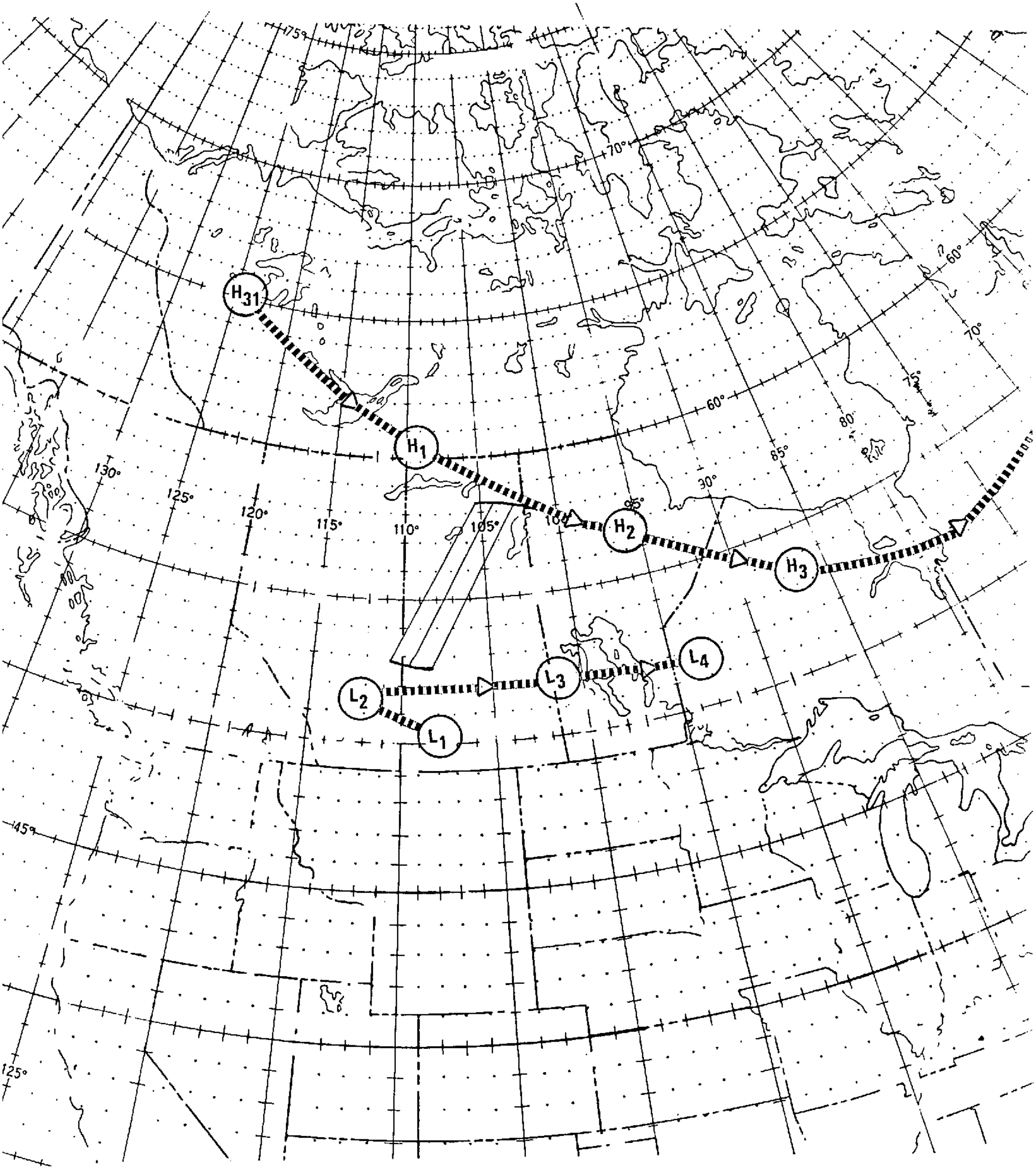

FIGURE 16. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 31 OCT 72 AND 04 NOV 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

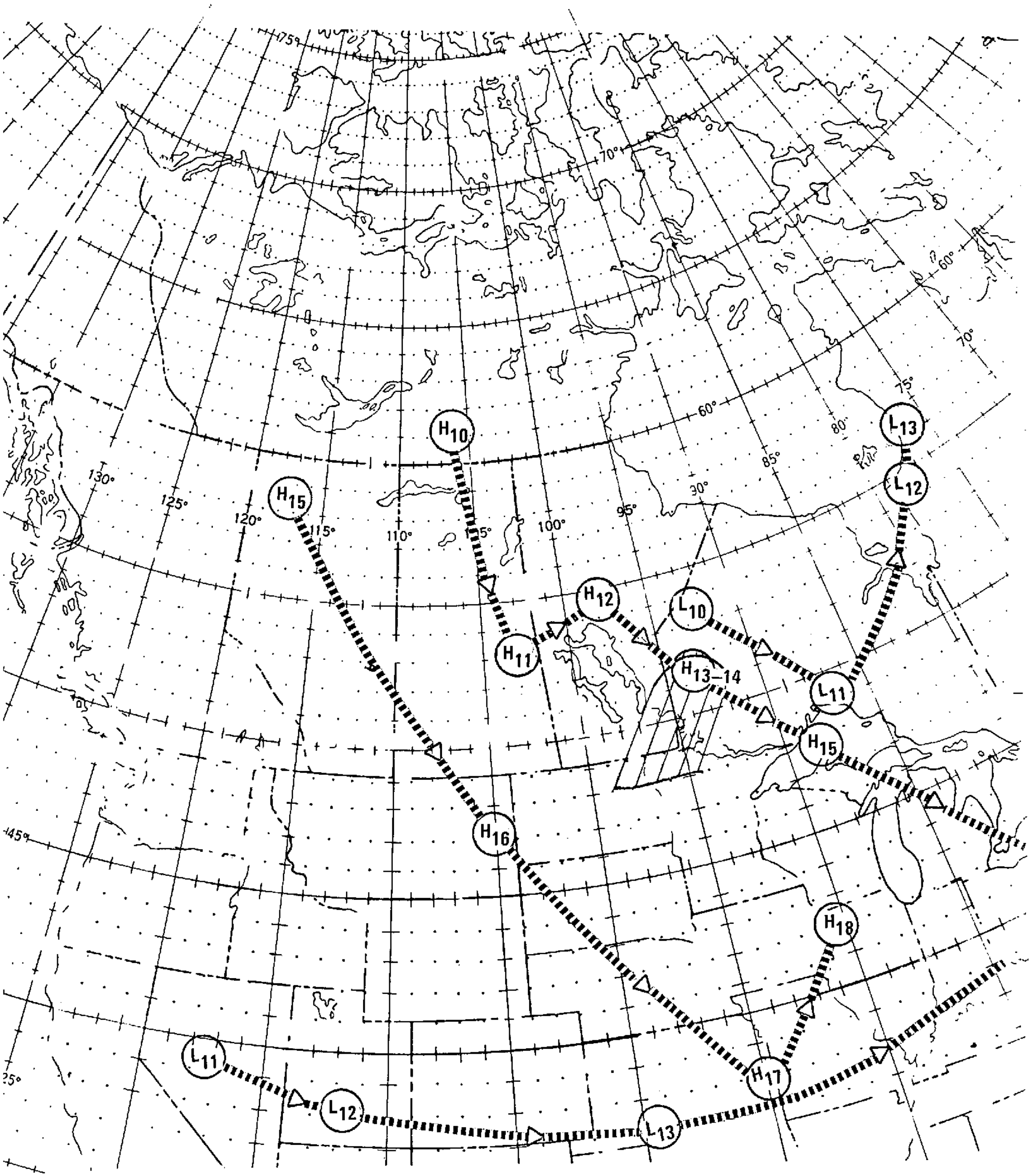

FIGURE 17. MOVEMENT OF IN MASSES IN CENTRAL NORTH AMERICA BETWEEN 10 NOV 72 AND 18 NOV 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zones Indicated)

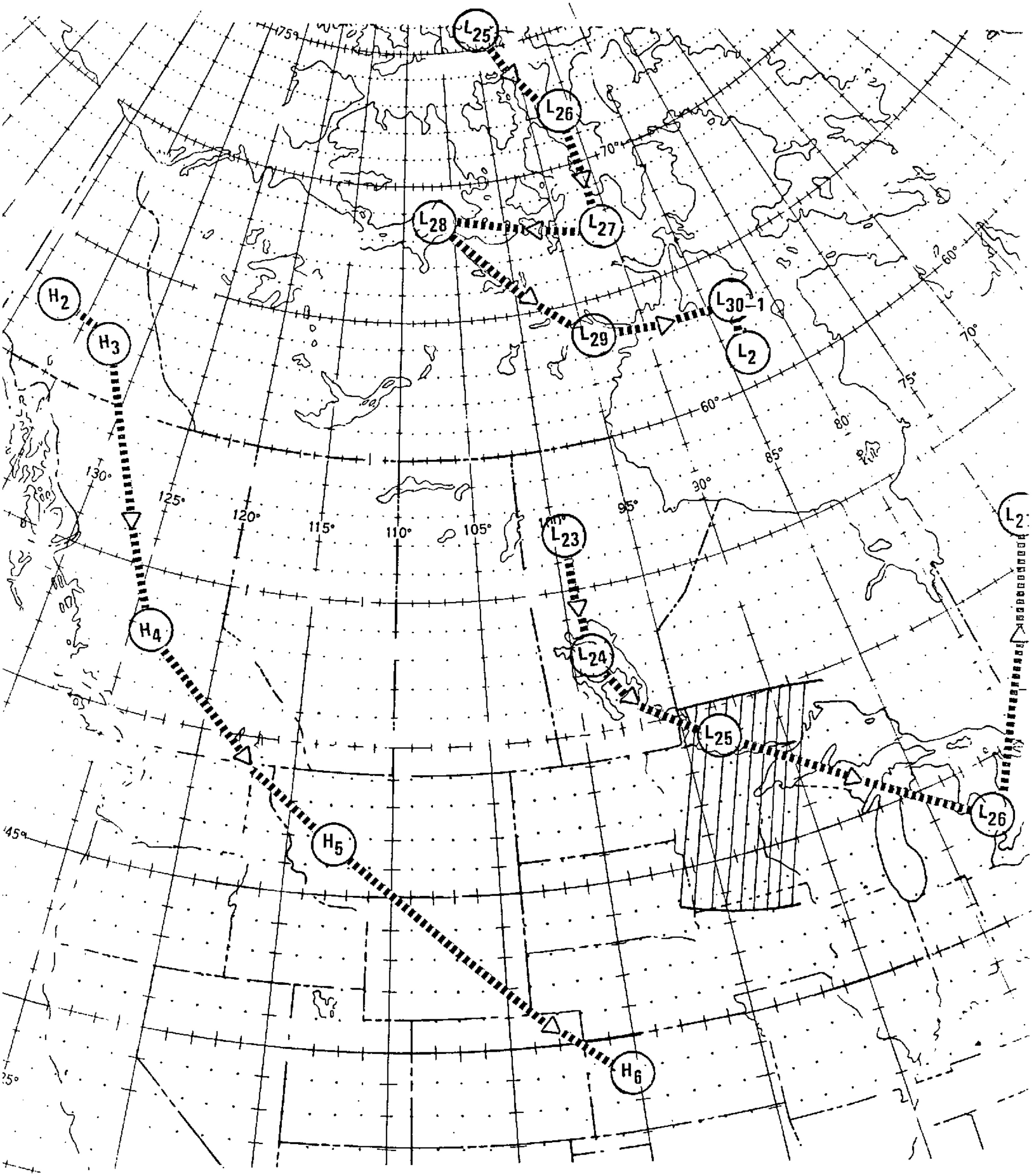

FIGURE 18. MOVEMENT OF AIR MASSES IN CENTRAL NORTH AMERICA BETWEEN 23 NOV 72 AND 6 DEC 72.
(H = High Pressure Mass; L = Low Pressure Mass; Subscript Indicates Day of Month; Observed Transition Zone Indicated)

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- Many polar continental cyclones originate in and/or travel along the trend of the transition zone.

- Polar continental anticyclones fail to cross the transition zone.

- Polar outbreak anticyclones pass directly across the transition zone without undergoing any apparent change.

These findings are wholly in accord with intuitive expectations regarding the ability of the transition zone to influence regional weather conditions. Namely, that as a source of relatively abundant heat and water vapor resulting from vigorous pre-freeze lake cooling, the transition zone would tend to strengthen cyclonic systems and weaken anticyclonic systems. During the 1972 freeze season the transition zone was not only the favored migration route for upper-latitude continental cyclones, but in no instance did polar continental anticyclones traverse the zone.

At this juncture it must be emphasized that the pressure centers plotted in Figures 12-18 do not reflect the total areal extent of these air masses. Certainly large portions of polar continental highs did cover the transition zone. Be that as it may, the consistencies of air-mass movements relative to the transition zone do suggest a strong interdependence, at least for the 1972 freeze season.

3.1.5 Comparison With Meteorological Data

Besides influencing the paths of weather systems across central North America, the transition zone may modify or otherwise affect the magnitude and distribution of important climatological parameters such as temperature and wind vector. Intuitively the transition zone represents a region of considerable convective turbulence, greater than average cloud cover, and above normal temperatures and precipitation. These conditions are a consequence of the flux of large quantities of heat and water vapor from rapidly cooling lake surfaces to the lower atmosphere; they should be amenable to testing by local and regional weather data, as discussed below.

3.1.5.1 Pressure (Intensification)

An analysis of the low pressure system traversing the transition zone during the period October 6-8 (Figure 12) shows that the system underwent considerable intensification. The system's minimum pressure decreased by 20 mb while in transit over the TZ [13]. Precipitation associated with this storm showed a definite increase with time: the maximum amounts were found in northwest Ontario, immediately south of the TZ. The transition zone could have played a role in the deepening of this storm and in the increased precipitation, but the proximity of Hudson Bay (Figure 12) may have been the predominant factor.

The influence of Hudson Bay can be inferred by the observed pressure intensification of all low pressure systems shown in Figure 12. Table 4 gives the pressure center minimum for each of these systems as a function of time. As previously described, pressure system 1 attained a 20 mb drop while migrating along the transition zone. Pressure system 2, which

Table 4. Cyclonic intensification through the transition zone for early October 1972 (see Figure 12). (Pressure center minima given in millibars; data taken from [13].)

		Low Pressure System			
	Date	1	2*	3	4
October	6	999	---	---	---
	7	992	---	---	---
	8	979	1007	---	---
	9	967	994	---	---
	10	972	1001	---	---
	11	---	994	---	---
	12	---	---	1007	---
	13	---	---	1005	---
	14	---	---	996	1014
	15	---	---	995	1003

*Pressure system 2 is assumed to pass south of the transition zone.

remained south of the TZ while crossing central North America, actually weakened on October 10; however, after crossing Hudson Bay the system reintensified by 7 mb. Pressure system 3 traveled rapidly through the TZ without undergoing any apparent change; after crossing Hudson Bay the system had intensified by 9 mb. Pressure system 4, which remained entirely within the transition zone, intensified by 11 mb.

An examination of cyclonic systems for the remainder of October and November revealed a similar intensification pattern: (a) those systems moving along the TZ intensified by about 10 mb, (b) crossing Hudson Bay produced an intensification of about 10 mb or less, and (c) low pressure systems outside the TZ experienced erratic pressure changes with net decreases of less than 10 mb. On the basis of these results, the transition zone apparently influenced cyclonic intensification as well as direction of flow.

Anticyclonic intensification offered a less consistent picture for the 1972 freeze season. Several polar continental highs whose centers passed just to the north of the TZ actually intensified (i.e., increased maximum pressure). No systematic variations in pressure change were observed in any of the anticyclones whose movements were tracked.

3.1.5.2 Precipitation and Dew Point

In order to estimate the transition zone's effect on precipitation, weather data from meteorological stations were combined and averaged over relatively small time intervals. Nine stations were selected at random for each averaging interval: 3 north of the TZ, 3 within the TZ, and 3 south of the TZ. Averaging intervals were chosen to coincide with known positions of the transition zone, leading to small gaps in the record.

Consistent trends in precipitation were not apparent from the short-term averaged data; however, the grand average showed that somewhat less precipitation was recorded in the transition zone (0.20 in) as opposed to areas both north (0.28 in) and south (0.25 in). This result is in agreement with the previous intensification studies which suggested that the TZ served as a source region for cyclonic storms; moisture accumulated from lakes within the TZ would be released outside the zone.

In addition to average precipitation values, time-averaged dew points and dew point temperature differences were also calculated for certain weather stations during the month of October. In almost every case the dew point temperature differences were smaller north of the transition zone, indicating that this was the region of moister air. However, this result could well have been an artifact of the data since only minimum temperature data from the North American Surface Charts were available to make the calculation. Radiational cooling effects, especially from snow and ice cover north of the TZ, would tend to artificially lower the dew point temperature difference.

3.1.5.3 Cloud Cover

Quantitative records of cloud cover were not available from the weather data base used in this investigation. However, some qualitative estimates of clouding can be made from the ERTS imagery of the study area. ERTS data were collected for approximately 40% of all possible scenes during the 1972 freeze season. Assuming that cloud cover was the principal constraint in taking imagery, this estimate gives some indication of the effect cloud cover can have during the freeze season.

Scattered views of the freeze transition zone have corroborated heavy cloud cover over the TZ, especially in the vicinity of the southern boundary. However estimates of cloud cover percentage both within and outside the TZ were not made.

3.1.5.4 Temperature

The relationship of air temperature, particularly running mean air temperature, to the migration of the transition is discussed in considerable detail in a later section of this report.

3.1.5.5 Wind

The predominant surface wind patterns of central Canada were examined to determine whether there exists a correlation with TZ location and movement. Monthly prevailing wind directions during 1972 for selected Canadian stations are depicted in Figures 19-22. The most consistent feature of these data is the regular northwesterly wind direction, especially north of 55°N latitude and around Hudson Bay. This trend reflects the general orientation of the TZ and the flow of air masses through the region. Similarly the tendency for the transition zone to assume more of a east-west pattern in western Ontario is largely corroborated by the wind data. Unfortunately the resolution of the data in time and space is insufficient to attempt a comparison with TZ migration trends.

As an aside, two interesting mesoscale meteorological phenomena are manifest by the wind data. In October (Figure 20) all four weather stations located on the shores of Great Slave Lake had offshore prevailing winds. In all liklihood such winds were probably a consequence of convective turbulence

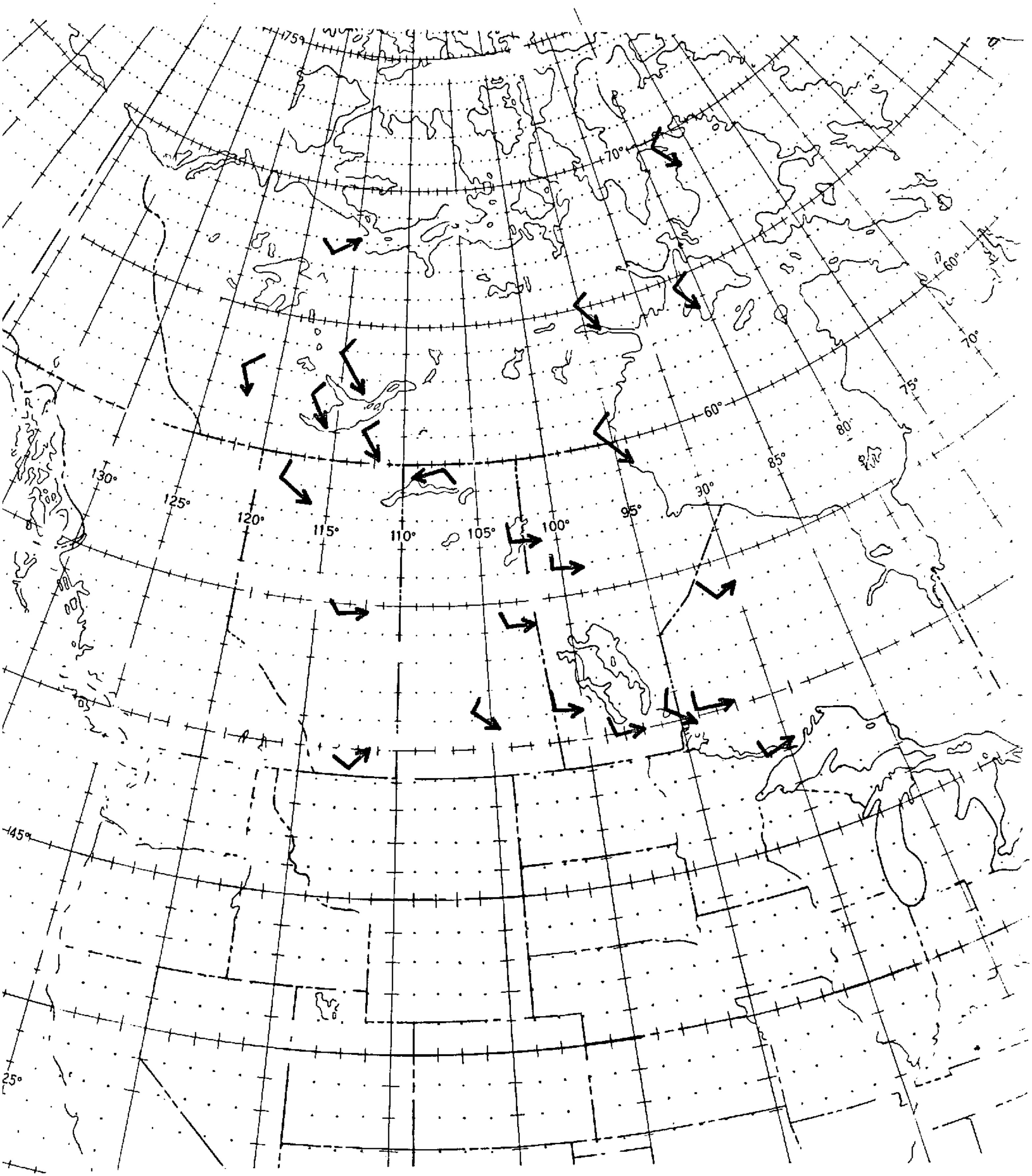

FIGURE 19. PREVAILING WIND DIRECTIONS FOR THE MONTH OF SEPTEMBER 1972. (ARROWS INDICATE DIRECTION TO WHICH WIND IS BLOWING.)

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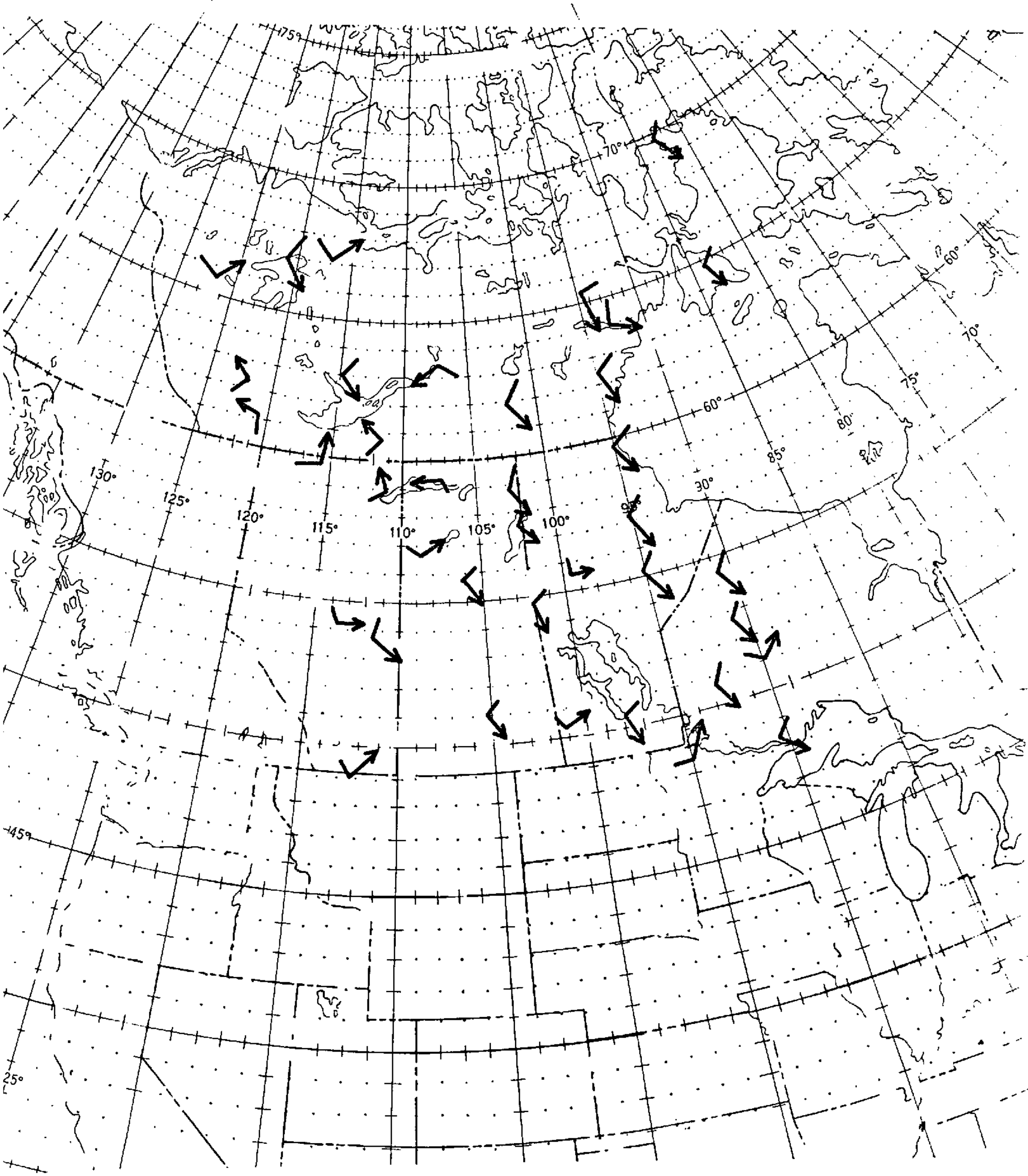

FIGURE 20. PREVAILING WIND DIRECTIONS FOR THE MONTH OF OCTOBER 1972.
(ARROWS INDICATE DIRECTION TO WHICH WIND IS BLOWING.)

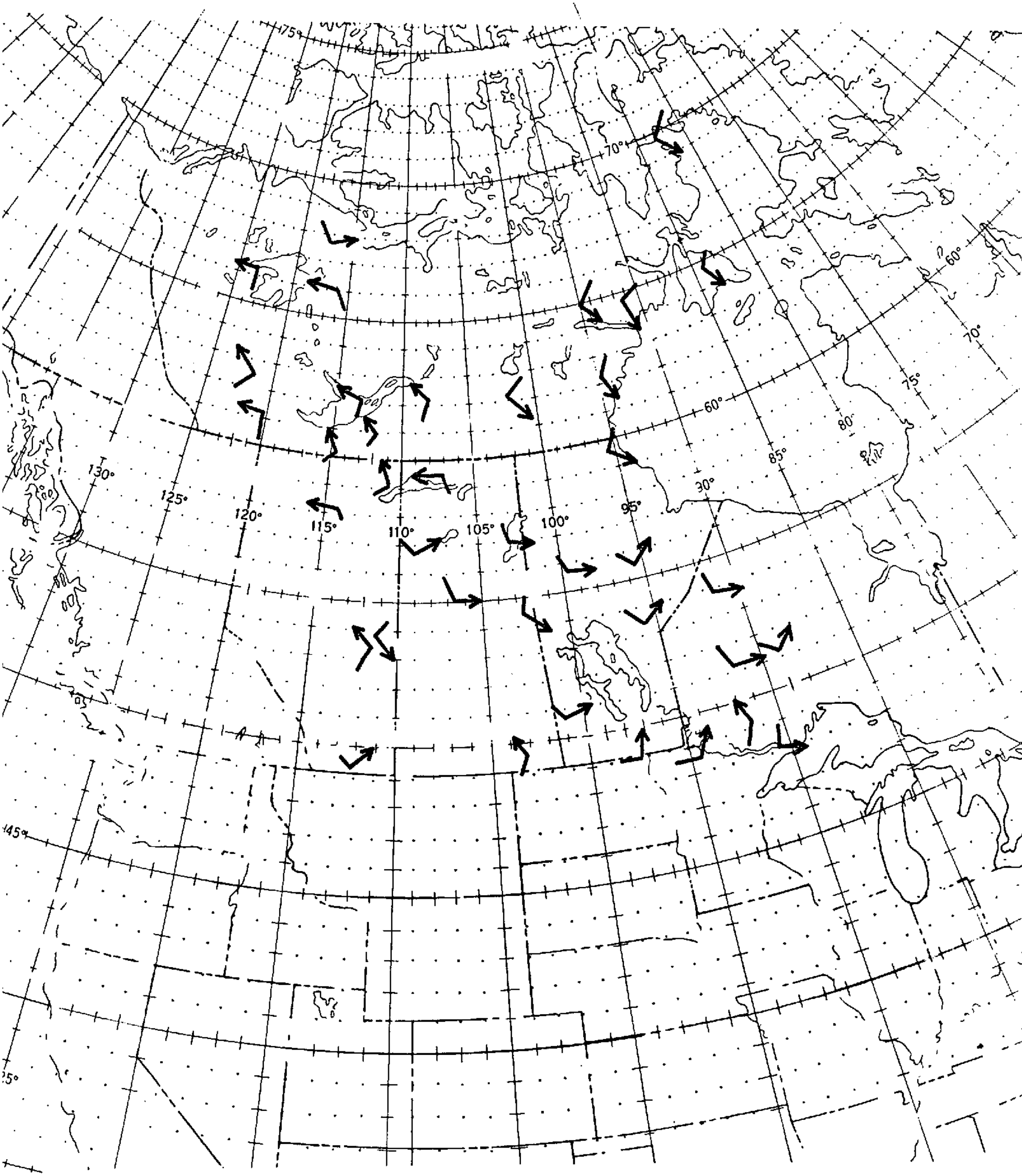

FIGURE 21. PREVAILING WIND DIRECTIONS FOR THE MONTH OF NOVEMBER 1972.
(ARROWS INDICATE DIRECTION TO WHICH WIND IS BLOWING.)

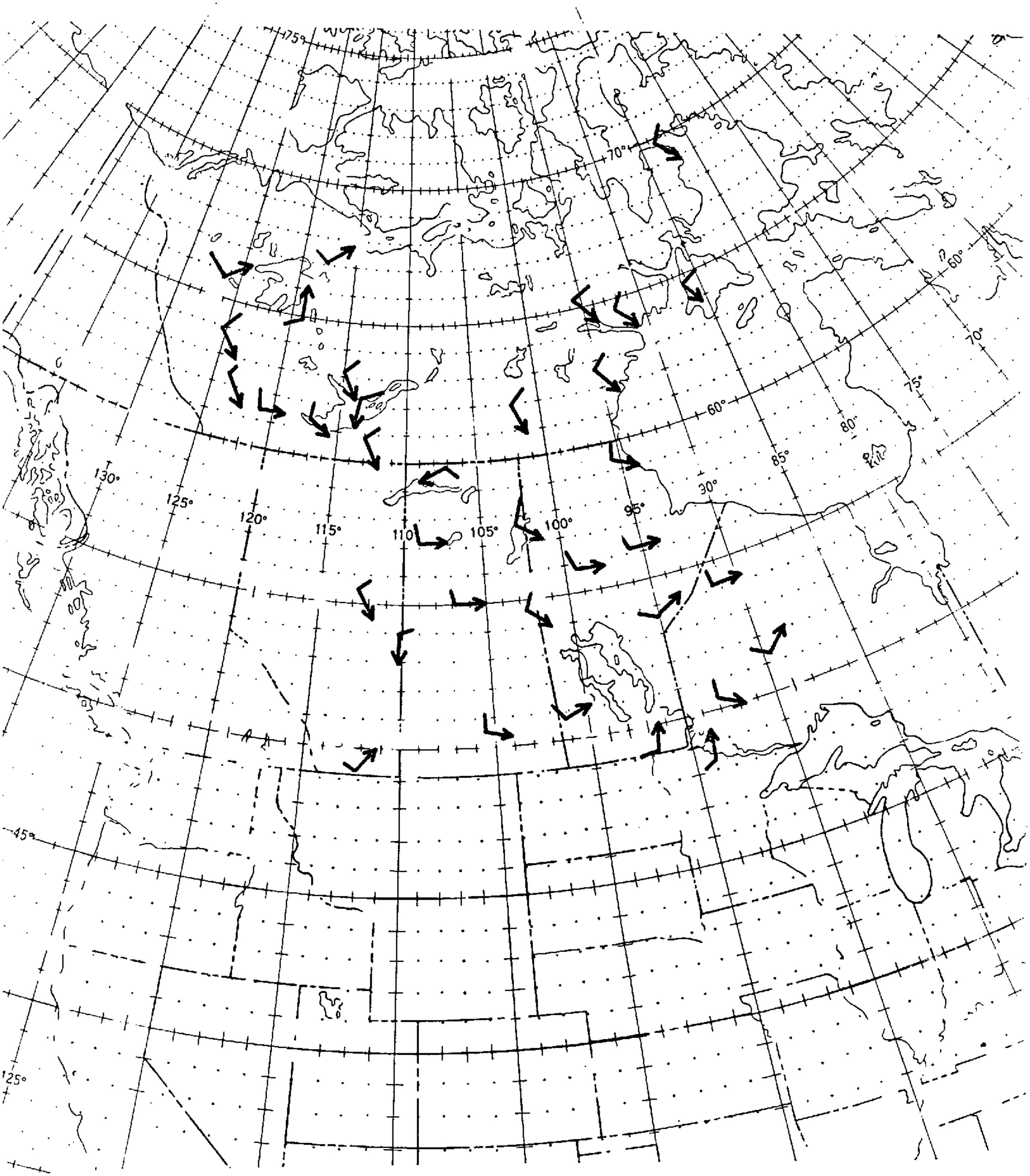

FIGURE 22. PREVAILING WIND DIRECTIONS FOR THE MONTH OF DECEMBER 1972.
(ARROWS INDICATE DIRECTION TO WHICH WIND IS BLOWING.)

generated over the lake due to the loss of heat and water vapor during autumnal mixing of the lake waters. (Recall that during October the lake served as a source area for several cyclonic storms (Figure 12).) Secondly, the Uranium City weather station located near Lake Athabasca experienced a persistent easterly wind throughout the 1972 freeze season. This direction was contrary to the prevailing flow at all other stations in the general vicinity. The Uranium City station must have been under the influence of some local factor, such as location relative to nearby terrain features, that masked the true direction of flow. These examples demonstrate that care must be taken in deriving generally valid regional conclusions based upon local meteorological observations.

3.2 THAW SEASON - SPRING 1973

The break-up portion of the 1972 ice year lasted approximately 120 days (i.e., mid-March to early July). During that time the ERTS-1 covered the test site in seven 18-day cycles. The geographical and temporal extent of the coverage greatly exceeded that for the previous freeze season (Appendix C), and the record is surely the most comprehensive of its kind ever obtained for ice surveying purposes.

3.2.1 Transition Zone Migration

The conditions for observing the thaw transition zone are the inverse of those for the freeze transition zone. During the thaw season, the smallest lakes accompanied by the faster flowing sections of most rivers, lose their ice cover early, whereas the largest lakes tend to retain their ice for longer periods of time. This is a consequence of more rapid solar heating of the water layer below the ice in small, relatively shallow lakes in comparison to heating of a similar layer in large, relatively deep lakes. In effect a greater volume of water must be heated in large lakes before they begin to thaw.

The northern transition zone boundary (NTZ) is marked by the trace of an irregular line of open or partially open lakes. Under thaw conditions these lakes are typically the smallest ones in the region. Progressing southward, the percentage of open lakes increases until a point is reached where all lakes are completely ice free. The line marking the last lakes possessing a discernable fraction of ice cover represents the southern transition zone boundary (STZ). In every case the STZ includes the largest and presumably deepest lakes in the area.

Many early thaw features not readily apparent from the visible bands of the ERTS multispectral scanner could easily be detected with band 7. Such early thaw features included: loss of snow cover, open fractures, fracture swarms, shoreline open water, open water at inlets and outlets, and mottled ice surfaces. Varying gray levels of reflectance from the ice surface, in contrast to a fairly uniform surface brightness, were interpreted as indicative of variable ice thickness, a presumed accompaniment to thawing.

Taken collectively, these features enabled lakes that were solidly frozen to be discriminated from those that had begun to show signs of thawing. Unexpectedly, a well-defined boundary could be drawn separating the two lake ice conditions; this line of separation was called the ice decay boundary (IDB). In every case in which both were visible the IDB lay well to the north of the transition zone. Obviously, the IDB has no counterpart during the freeze season, since at that time lakes are either frozen over or they are not.

The thaw season transition zone was taken as the smoothed average of previously reported base observations [14,15]. That is, an average trend of the daily variations in the positions of the NTZ and STZ was assumed to represent the trend of the zone over a period of time. In such manner, consecutive day inconsistencies were largely eliminated. An identical technique was applied to the ice decay boundary (IDB).

Averaged transition zone boundaries and ice decay boundaries for the 1973 thaw season are displayed in Figures 23 through 29. Interpolated boundaries are marked by dashes, and dates mark the approximate time and location of a given boundary observation. Typically, the outlined transition zone and IDB increase in age from east to west, but this is not always the case (e.g., Figure 26). By quickly scanning the figures from page to page, a sense of the motion of the zone can be obtained.

Two or more observations on the same day, separated by about 1500 miles give an instantaneous view of the transition zone on a continental scale. This view is readily apparent in Figures 26-27. These figures confirm a pronounced northwest-southeast trend of the transition zone independent of any temporal variations. Thus the thaw transition zone displays a remarkable similarity in orientation to the freeze transition zone. Apparently, solar radiation plays less of a role in melting ice than this investigator had thought, and sensible and latent heat transfer are the controlling factors.

The transition zone observations from the 1973 thaw season aptly demonstrate the capability of ERTS to cover wide-ranging, transient phenomena in both space and time.

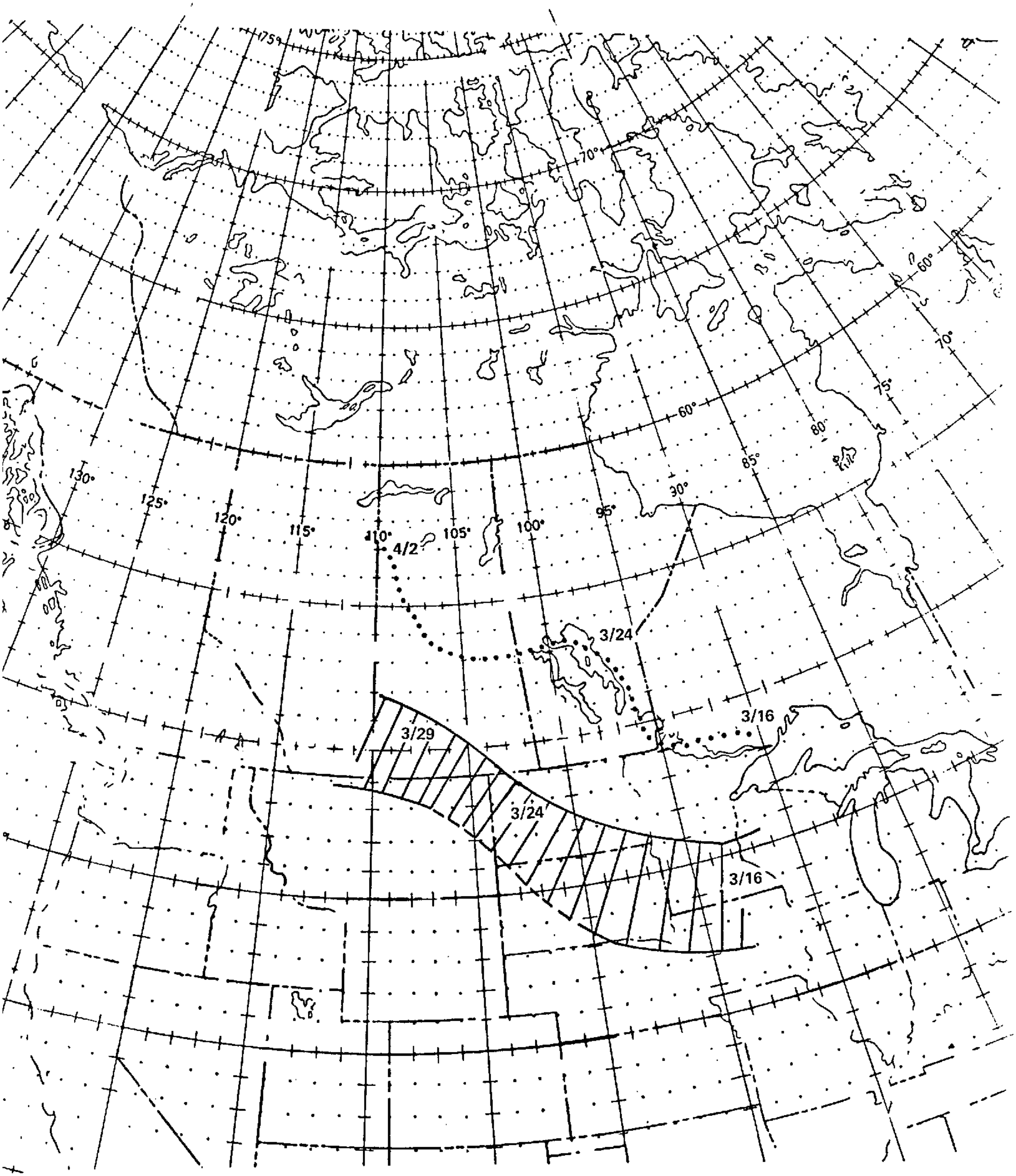

FIGURE 23. LAKE THAW TRANSITION ZONE AND ICE DECAY BOUNDARY (DOTTED) FOR THE PERIOD MARCH 16 THROUGH APRIL 2, 1973. DATES ON MAP INDICATE APPROXIMATE POSITIONS OF BOUNDARIES AT THOSE TIMES.

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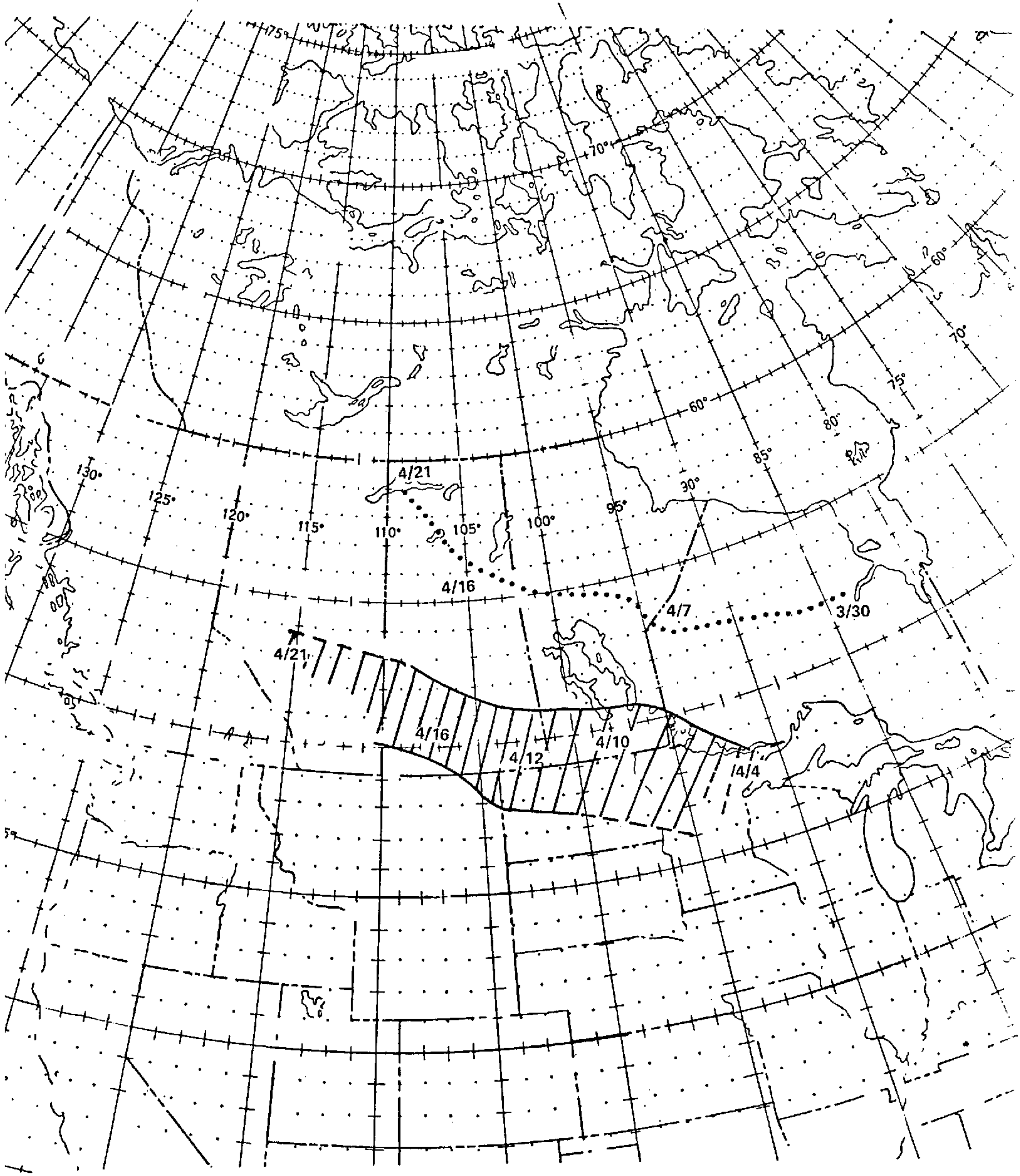

FIGURE 24. LAKE THAW TRANSITION ZONE AND ICE DECAY BOUNDARY (DOTTED) FOR THE PERIOD APRIL 4 THROUGH APRIL 21, 1973. DATES ON MAP INDICATE APPROXIMATE POSITION OF BOUNDARIES AT THOSE TIMES.

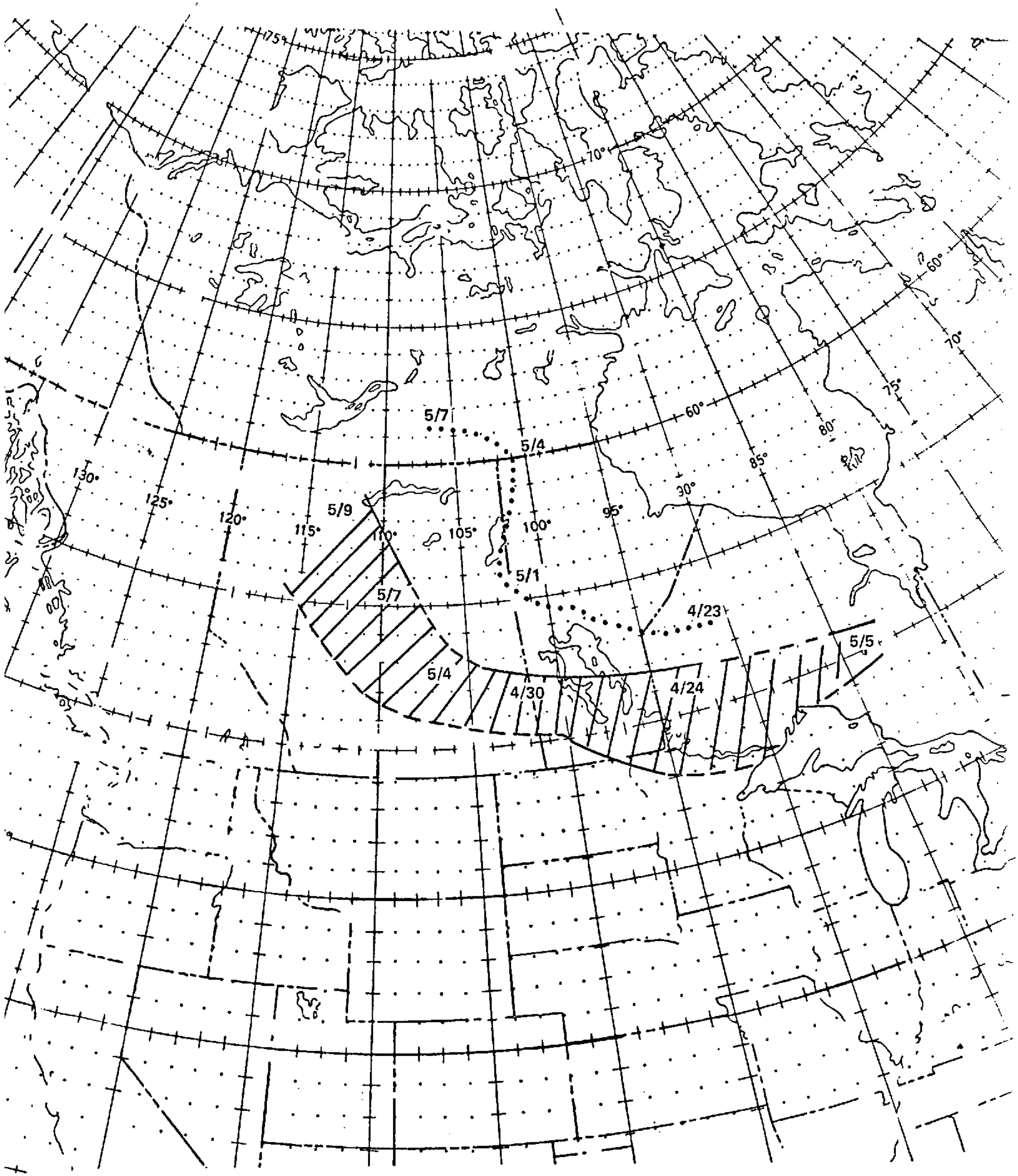

FIGURE 25. LAKE THAW TRANSITION ZONE AND ICE DECAY BOUNDARY (DOTTED) FOR THE PERIOD APRIL 23 THROUGH MAY 9, 1973. DATES ON MAPS INDICATE APPROXIMATE POSITION OF BOUNDARIES AT THOSE TIMES.

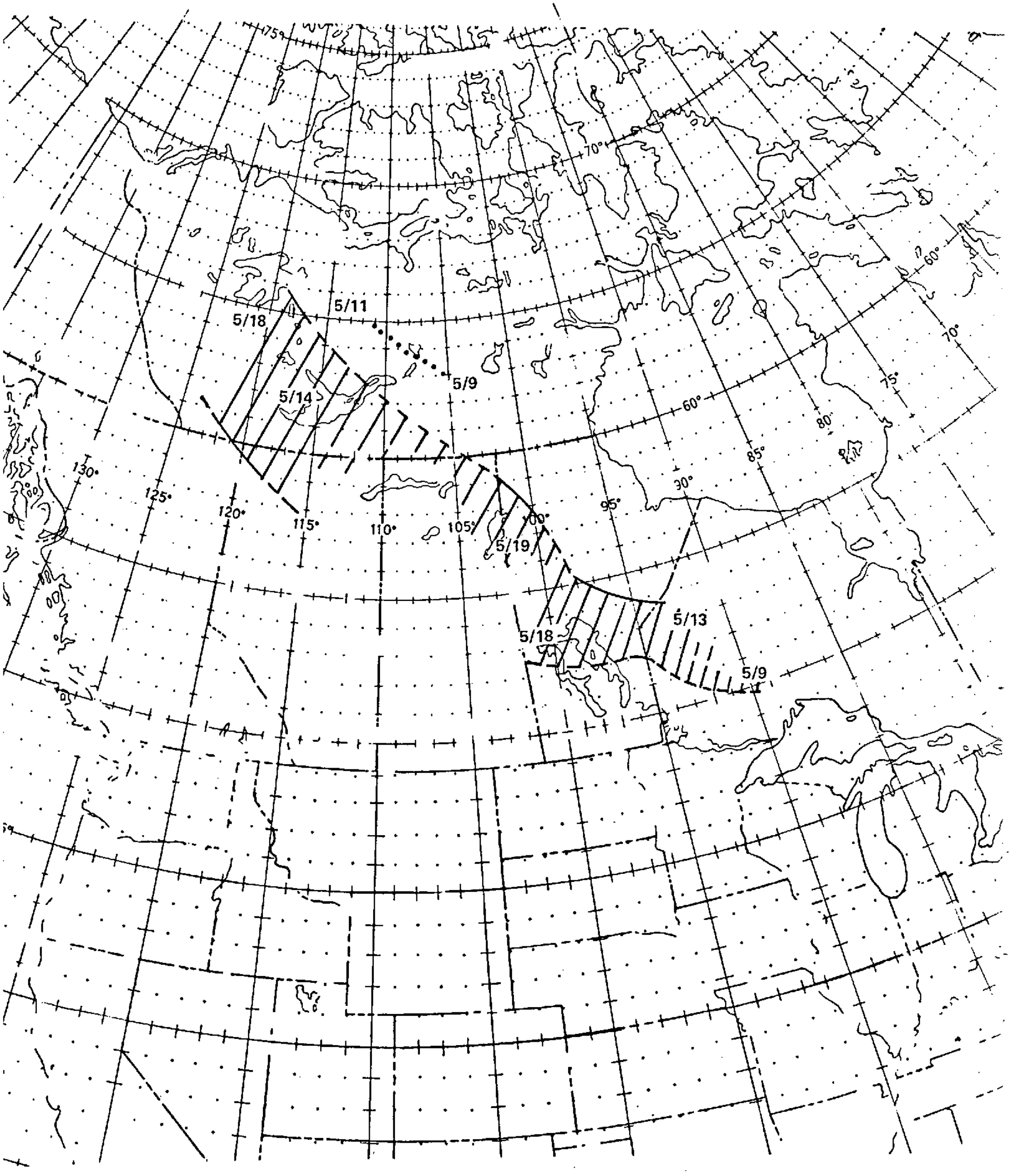

FIGURE 26. LAKE THAW TRANSITION ZONE AND ICE DECAY BOUNDARY (DOTTED) FOR THE PERIOD MAY 9 THROUGH MAY 18, 1973. DATES ON MAP INDICATE APPROXIMATE POSITION OF BOUNDARIES AT THOSE TIMES.

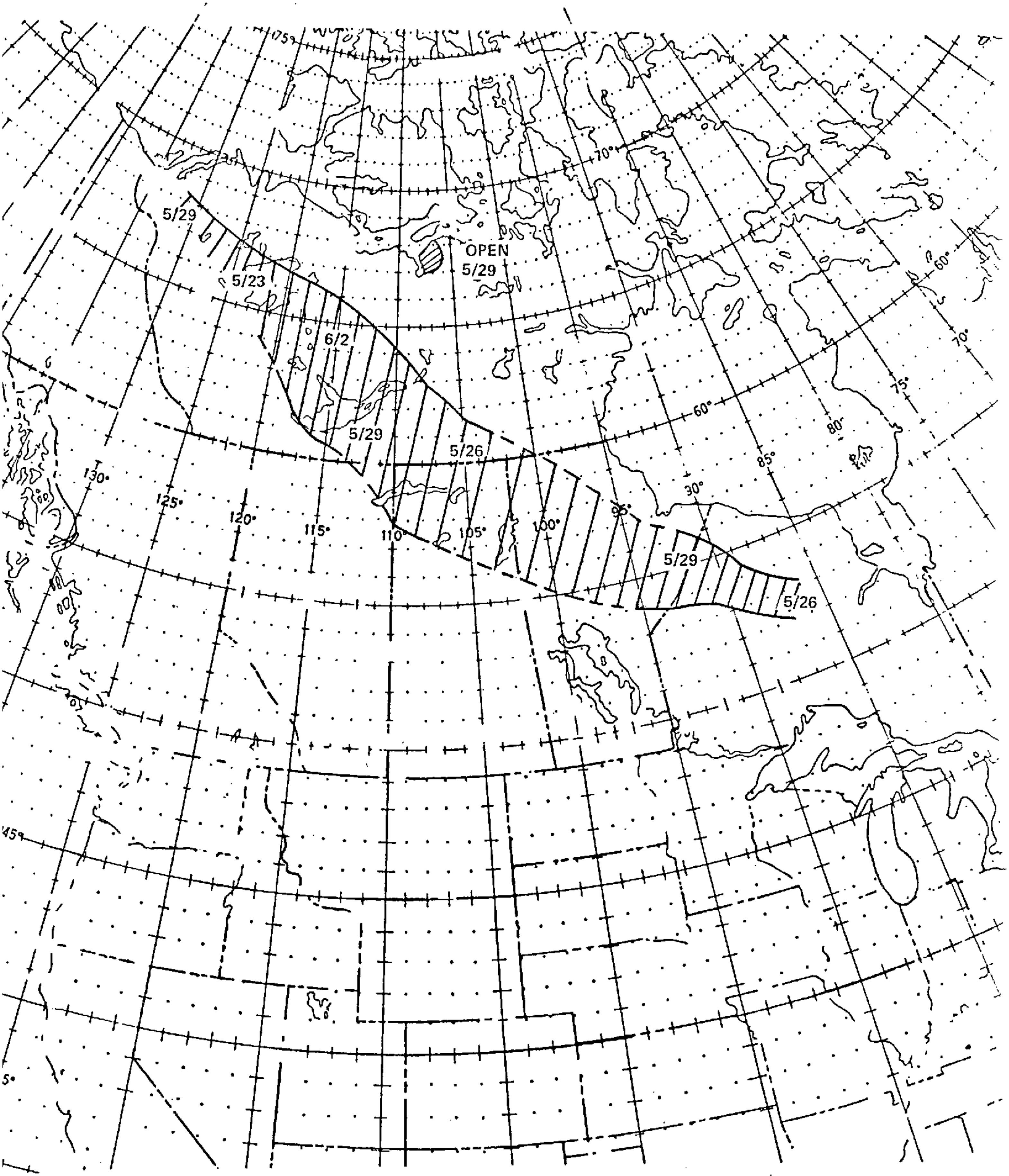

FIGURE 27. LAKE THAW TRANSITION ZONE FOR THE PERIOD MAY 26 THROUGH JUNE 2, 1973. DATES ON MAP INDICATE APPROXIMATE POSITIONS OF BOUNDARIES AT THOSE TIMES.

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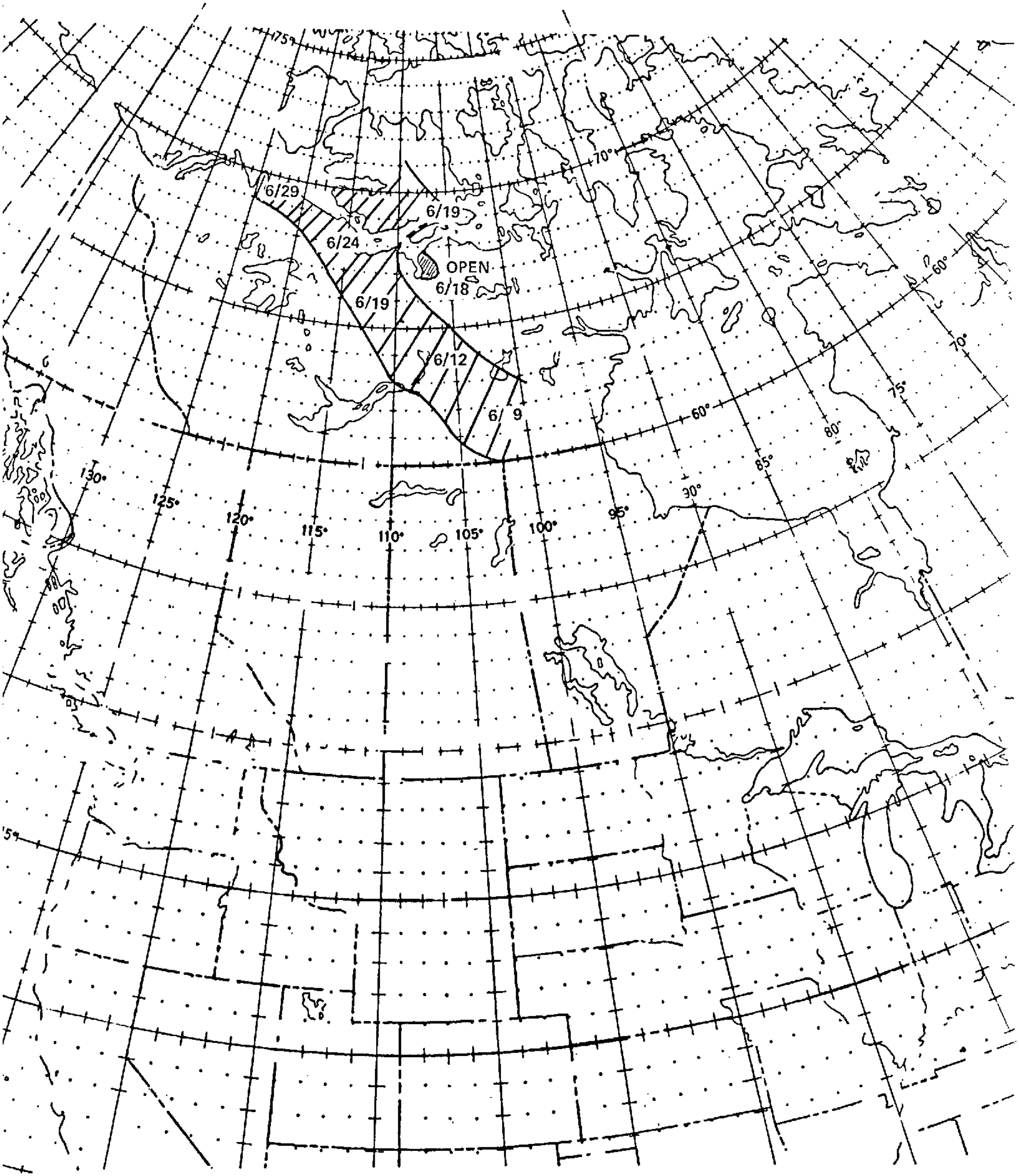

FIGURE 28. LAKE THAW TRANSITION ZONE FOR THE PERIOD JUNE 9 THROUGH JUNE 29, 1973. DATES ON MAP INDICATE APPROXIMATE POSITIONS OF BOUNDARIES AT THOSE TIMES.

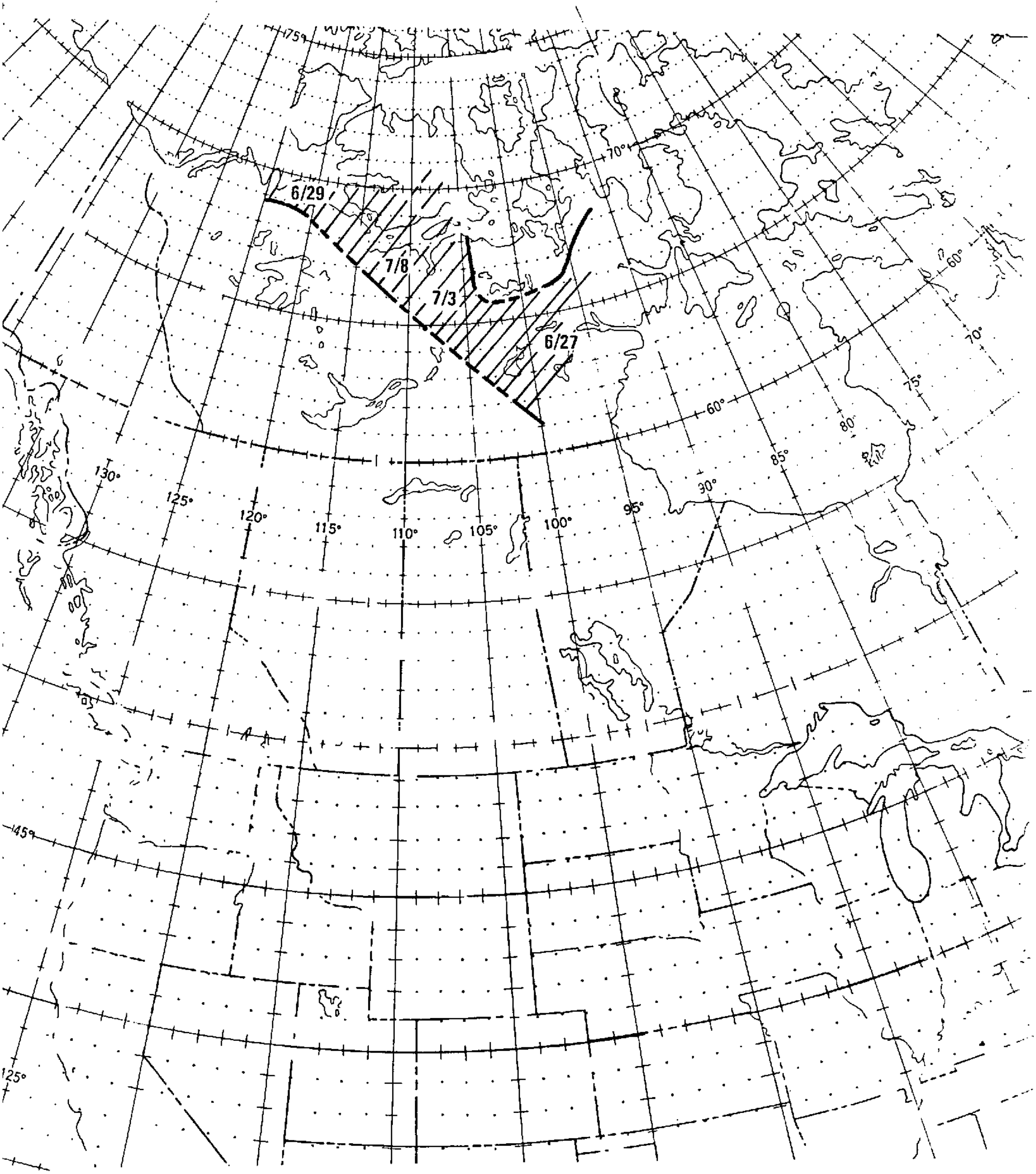

FIGURE 29. LAKE THAW TRANSITION ZONE FOR THE PERIOD JUNE 27 THROUGH JULY 8, 1973. DATES ON MAP INDICATE APPROXIMATE POSITIONS OF BOUNDARIES AT THOSE TIMES.

3.2.2 Comparison With Ground Truth

The observed transition zones were compared with the exact breakup dates of a number of Canadian lakes in the same manner as was done for the freeze season. The thaw (breakup) dates of the ground truth lakes are superposed on the TZ locations in Figures 30-33. If the transition zones are located properly, thaw dates north of the zone should post-date the period of observation, whereas thaw dates south of the zone should precede the observation period. An examination of Figures 30-33 reveals that the above criteria are satisfied in every case but two.

In the first exception Wascana Lake, Saskatchewan (030464) (Figure 30) has an ice clearing date of March 15, approximately one month earlier than its historical mean date. The question of the ice breakup date for Wascana Lake was taken up with the Field Meteorological Systems Branch of the Canadian Atmospheric Environment Service, the group responsible for maintaining the ice record. The early thaw date was confirmed and was attributed to exceptionally mild late winter weather in 1973 [16]. Meteorological records show that temperatures averaged 6-12°F above normal in southern Saskatchewan for both January and February.

All in all the error in locating the TZ relative to Wascana Lake is negligible. The important point to note is that the unusually early thawing of the lakes of southern Saskatchewan was correctly interpreted from the ERTS imagery; the result was a transition zone that swung well to the north in that part of the test site (Figures 23, 24 and 30).

The other exception, Lake Minnewanka, Alberta (020084) (Figure 32) is an artificial waterbody created by the damming of a narrow canyon at the base of the Rocky Mountains. Given its high altitude and the protection of the surrounding

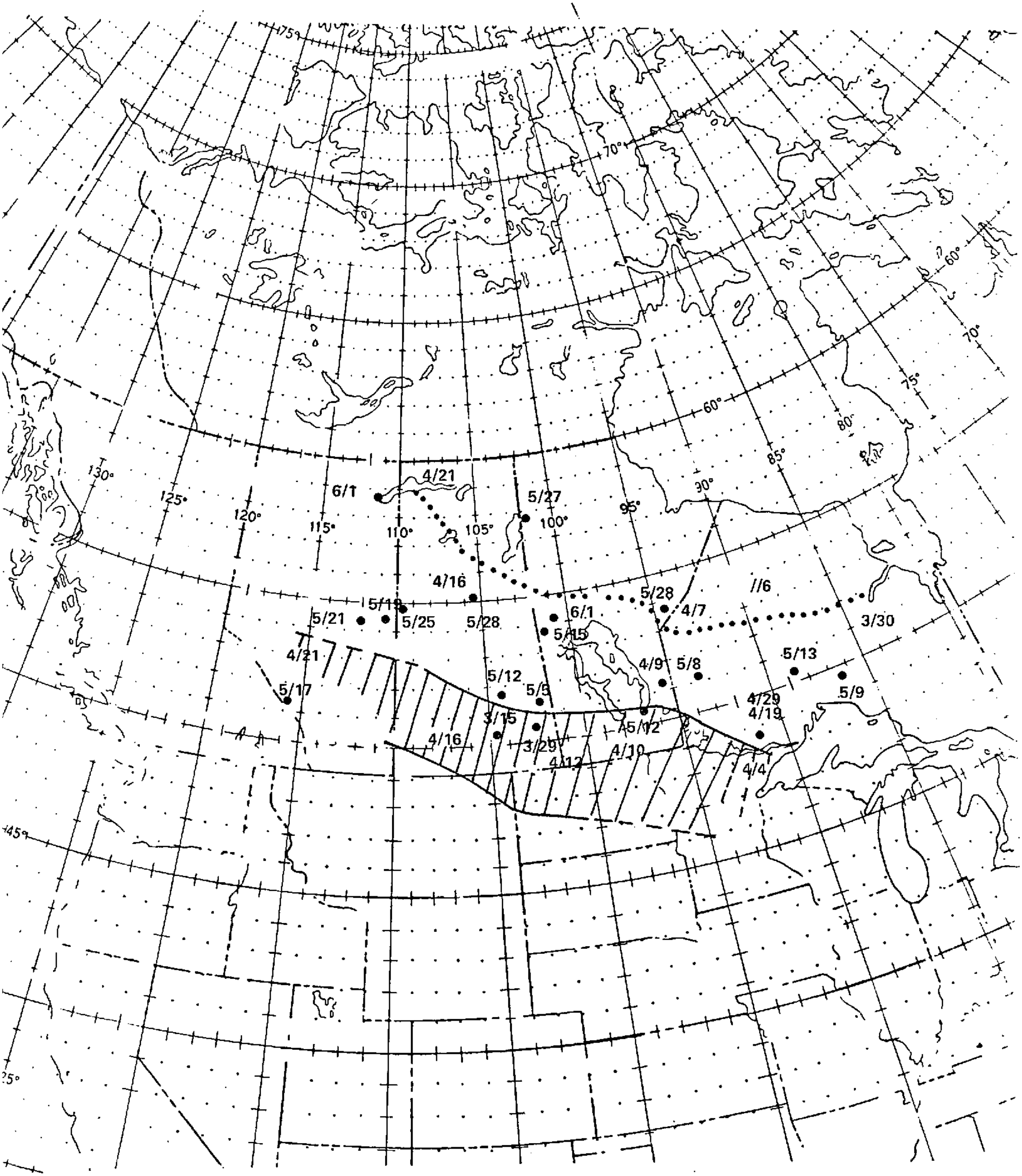

FIGURE 30. LAKE ICE BREAKUP DATES AS OBSERVED AT GROUND STATIONS AND THE POSITION OF THE TRANSITION ZONE FOR THE PERIOD APRIL 4 THROUGH APRIL 21, 1973.

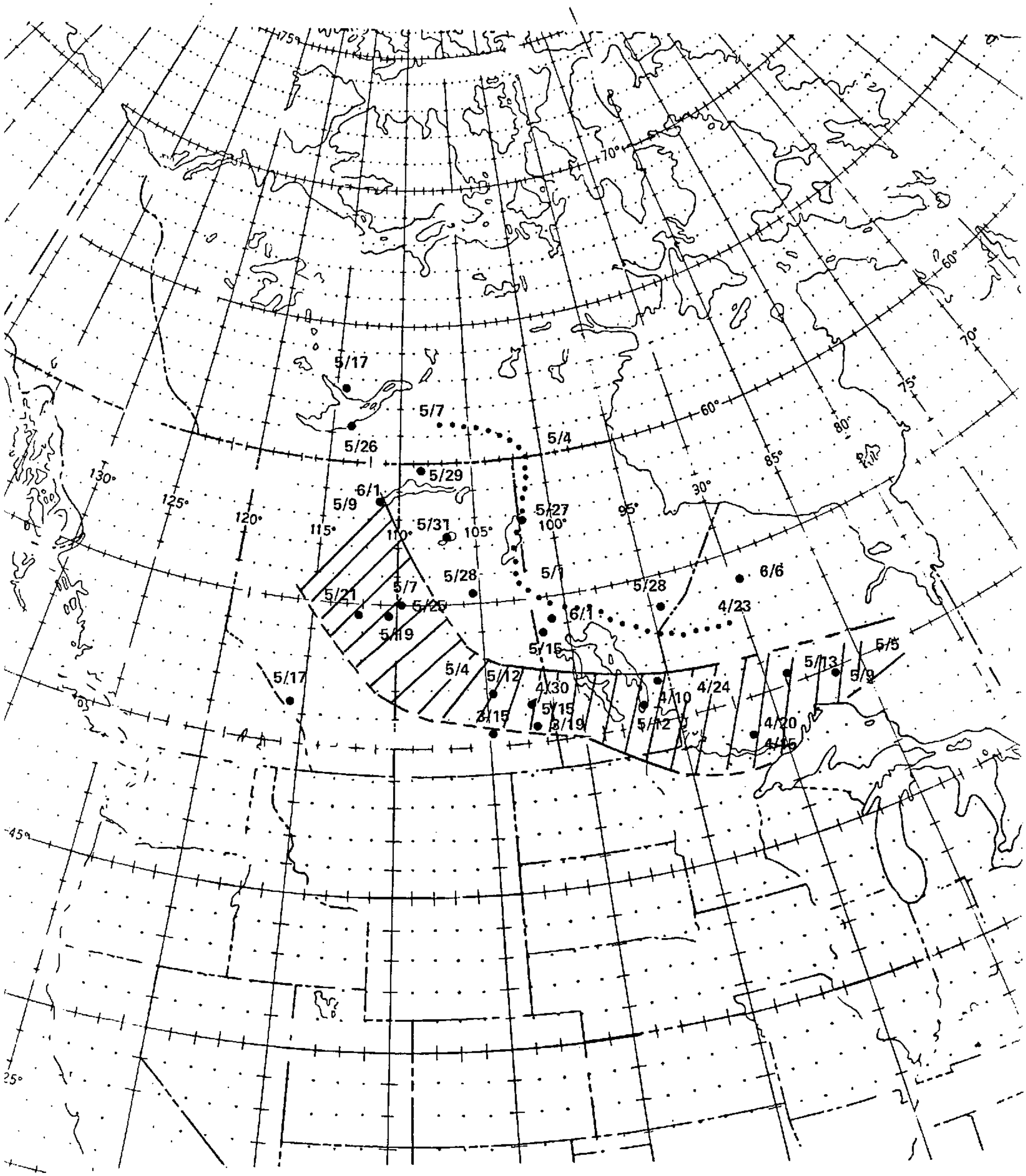

FIGURE 31. LAKE ICE BREAKUP DATES AS OBSERVED AT GROUND STATIONS AND THE POSITION OF THE TRANSITION ZONE FOR THE PERIOD APRIL 23 THROUGH MAY 9, 1973.

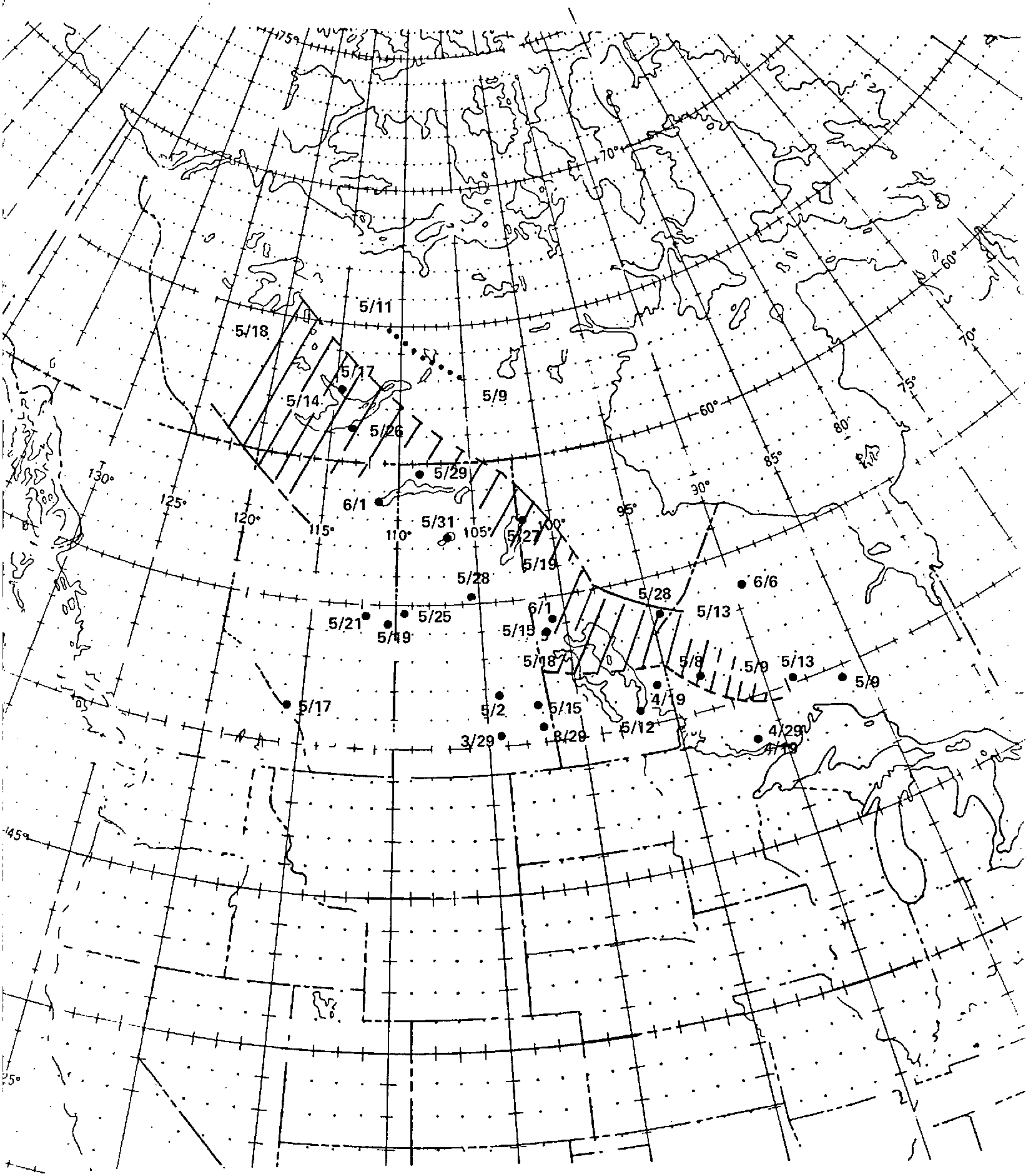

FIGURE 32. LAKE ICE BREAKUP DATES AS OBSERVED AT GROUND STATIONS AND THE POSITION OF THE TRANSITION ZONE FOR THE PERIOD MAY 9 THROUGH MAY 18, 1973.

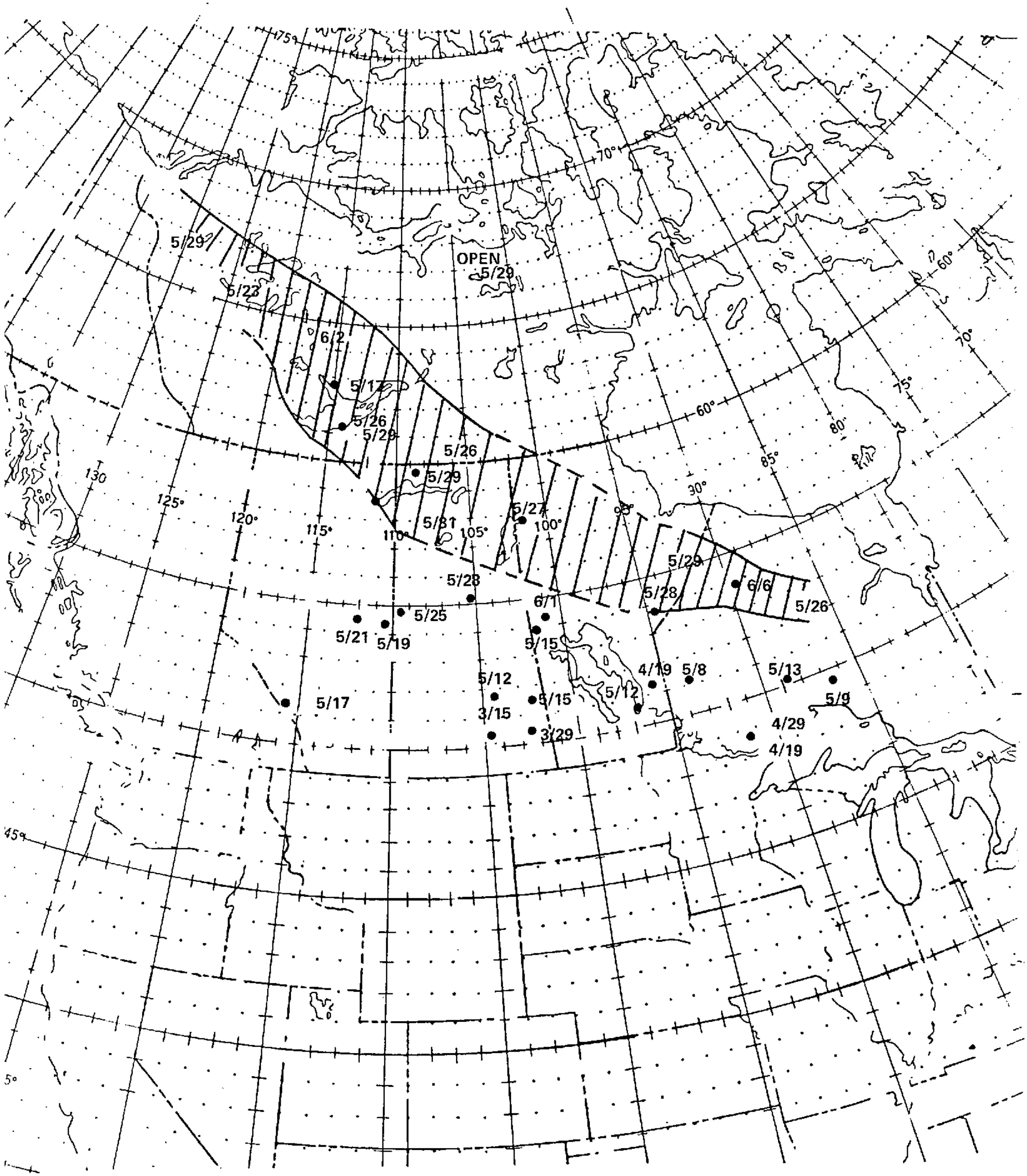

FIGURE 33. LAKE ICE BREAKUP DATES AS OBSERVED AT GROUND STATIONS AND THE POSITION OF THE TRANSITION ZONE FOR THE PERIOD MAY 26 THROUGH JUNE 2, 1973.

mountains, it is not surprising that Lake Minnewanka should thaw later than nearby lakes in the low flatlands to the east. In this case the lake is anomalous.

3.2.3 Comparison With Earlier Studies

Comparisons of the location and orientation of transition zones observed by McFadden [12] in 1963 and 1964 agree quite well with the 1973 transition zone at similar points in time. In addition, lake "break-up lines," reported by Ferguson and Cork [17] from an analysis of weather satellite imagery taken over the period 1967 through 1970, closely resemble the STZ ("deep lake thaw line") in general trend and direction of migration. Both earlier studies confirm the consistent northwest-southeast orientation of the transition zone throughout the thaw season.

3.2.4 Comparison With Weather Systems

An attempt to correlate the thaw transition zone with the movement of dominant air masses proved to be largely unsuccessful, and a detailed analysis of vernal weather patterns was not justified. However, a few generalities are instructive.

During March of 1973 the predominant flow of both cyclones and anticyclones was west to east. In April this flow was largely diverted to a north to south direction over the mid-continent, and by May the principal flow direction had shifted northwest to southwest. Finally, the June trend became once again west to east. To a first approximation these directional trends in the flow of upper latitude air masses are reflected in TZ orientations, allowing for a lag period of several weeks (see Figures 23-29). Apparently the 1973 thaw transition zone acted as a passive agent relative to the flow of air masses, however, its own orientation shifted in response to that flow.

These findings are consistent with the supposition that unlike lake freezing, which can influence weather patterns through the release of large amounts of heat and water vapor to the atmosphere, the thawing of lakes should not be an important factor in regulating weather, as only the absorption of a fairly small amount of atmospheric heat is involved.

3.2.5 Comparison With Meteorological Data

Due to a one year delay period in the receipt of Canadian weather data, a detailed analysis of meteorological parameters was not attempted. However, air temperature data from selected weather stations was used in an investigation of running mean temperature, the subject of the following section.

3.3 RUNNING MEAN TEMPERATURE STUDY

As one means of examining the interrelationship of the lake transition zone and regional climate, a task was begun to determine running mean temperatures for selected Canadian weather stations. The running mean temperature (RMT) is simply the mean daily air temperature averaged over a span of time, usually measured in days. Expressed mathematically the RMT for a number of days, n, is:

$$RMT_n = \frac{1}{n} \sum_{i=1}^{n} \bar{T}_i ,$$

where $\overline{T}$ is the mean daily air temperature. In effect the RMT_n is an integrator of mean air temperature for the previous n days. Thus, RMT_{30} can be regarded as the mean monthly temperature, and RMT_1 is just another expression for the daily mean temperature.

By advancing the RMT calculation in successive days, the variation of integrated mean temperature over a period of time, such as a season, can be studied. This was the approach adopted for this investigation.

Of the 18 weather stations whose meteorological records were used, 11 were located in Manitoba and 7 in western Ontario (Figure 2). These stations provided reasonably adequate geographical coverage of the east-central portion of the test site. The coverage periods were restricted to those ice years during which the transition zone was observed (i.e., 1961, 1963, 1972).

3.3.1 Running Mean Temperature - Freeze Season

McFadden [12] was able to show that lakes whose mean depths exceed 6 meters freeze over very close to the intersection date of the 40-day running mean air temperature (RMT_{40}) and the freezing temperature of water (32°F). He further suggested that lakes with mean depths less than 6 meters freeze over at about the time the 3-day running mean temperature (RMT_3) reaches the freezing temperature. A sample of his results for The Pas weather station during the 1961 freeze season is shown in Figure 34. The agreement between the observed freeze dates for both shallow and deep lakes and the intersection dates of the RMT curves with the freezing temperature is quite good. On the whole, the sample is typical of the results obtained for all weather stations used in McFadden's study.

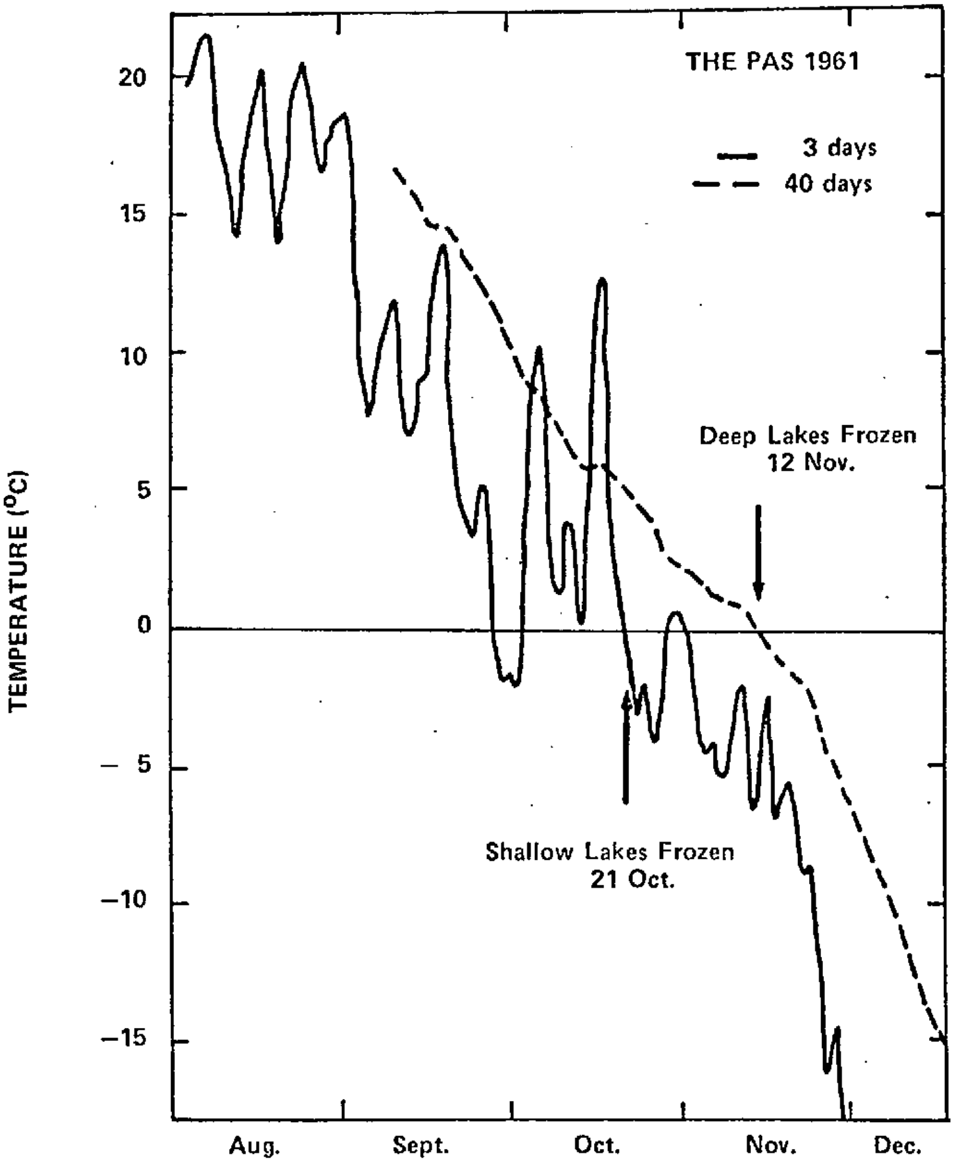

FIGURE 34. COMPARISON OF FREEZE DATES AND THE 3–DAY AND 40–DAY RUNNING MEAN AIR TEMPERATURES AT THE PAS, MANITOBA FOR 1961. (FROM McFADDEN [12])

The possibility of rendering McFadden's findings in map form rather than in graphical representation, was considered as a supplemental effort to this investigation. A map has the inherent quality of adding a 2-dimensional perspective to any observation which, in turn, can serve to enhance spatial features of the observation that otherwise would remain obscure. The approach adopted here was to plot the observed location of the transition zone on a map and compare that with computed RMT_n for weather stations in the vicinity.

By definition, the "deep-lake freeze line" and the northern transition zone boundary (NTZ) are identical, as are the "shallow-lake freeze line" and the southern transition zone boundary (STZ). Therefore, the deep-lake and shallow-lake freeze dates observed by McFadden are equivalent to the passage of the transition zone. This fact justifies a comparison of the transition zone and running mean temperature.

A comparison of McFadden's observed transition zone for the 1961 and 1963 freeze seasons with the calculated RMT_{40} and RMT_{10} is presented in Figures 35-38. The 10-day running mean temperature was chosen because this base period produced fewer high frequency oscillations than the 3-day period used by McFadden (Figure 34).

If McFadden's criterion is correct, the NTZ and the RMT_{40} freezing temperature isotherm (32°F) should coincide, as should the STZ and the RMT_{10} freezing temperature isotherm. A close examination of the 1961 freeze season (Figures 35-37) reveals that the criterion is indeed met, at least at the scale of the weather station spacing. In every instance, all stations to the north of the NTZ have a RMT_{40} less than 32°F, whereas all stations south of the NTZ exceed 32°F. Similarly, all stations north of the STZ have a RMT_{10} less than 32°F, and all stations south of the STZ exceed 32°F. Those stations

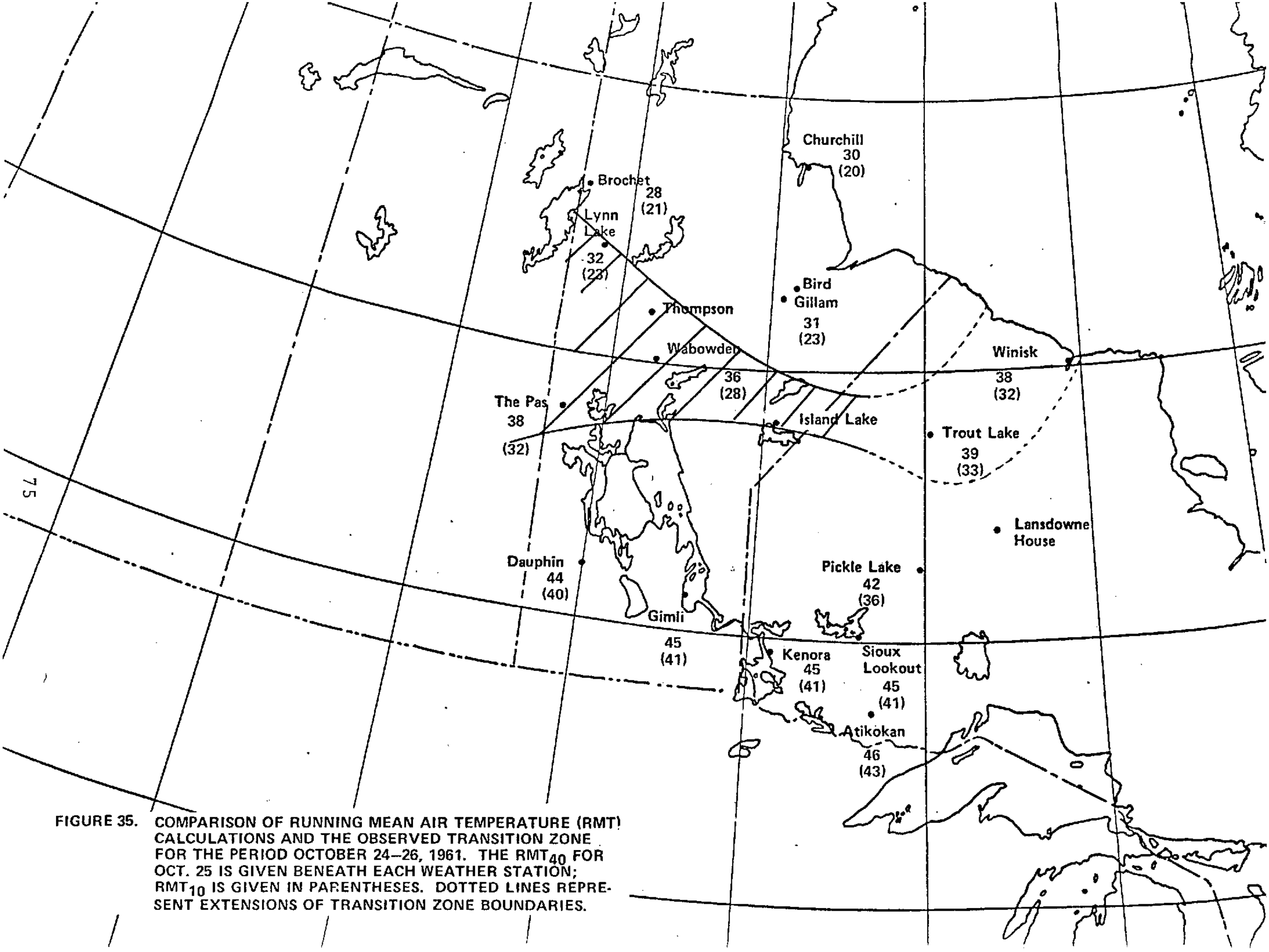

FIGURE 35. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD OCTOBER 24–26, 1961. THE RMT_{40} FOR OCT. 25 IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES. DOTTED LINES REPRESENT EXTENSIONS OF TRANSITION ZONE BOUNDARIES.

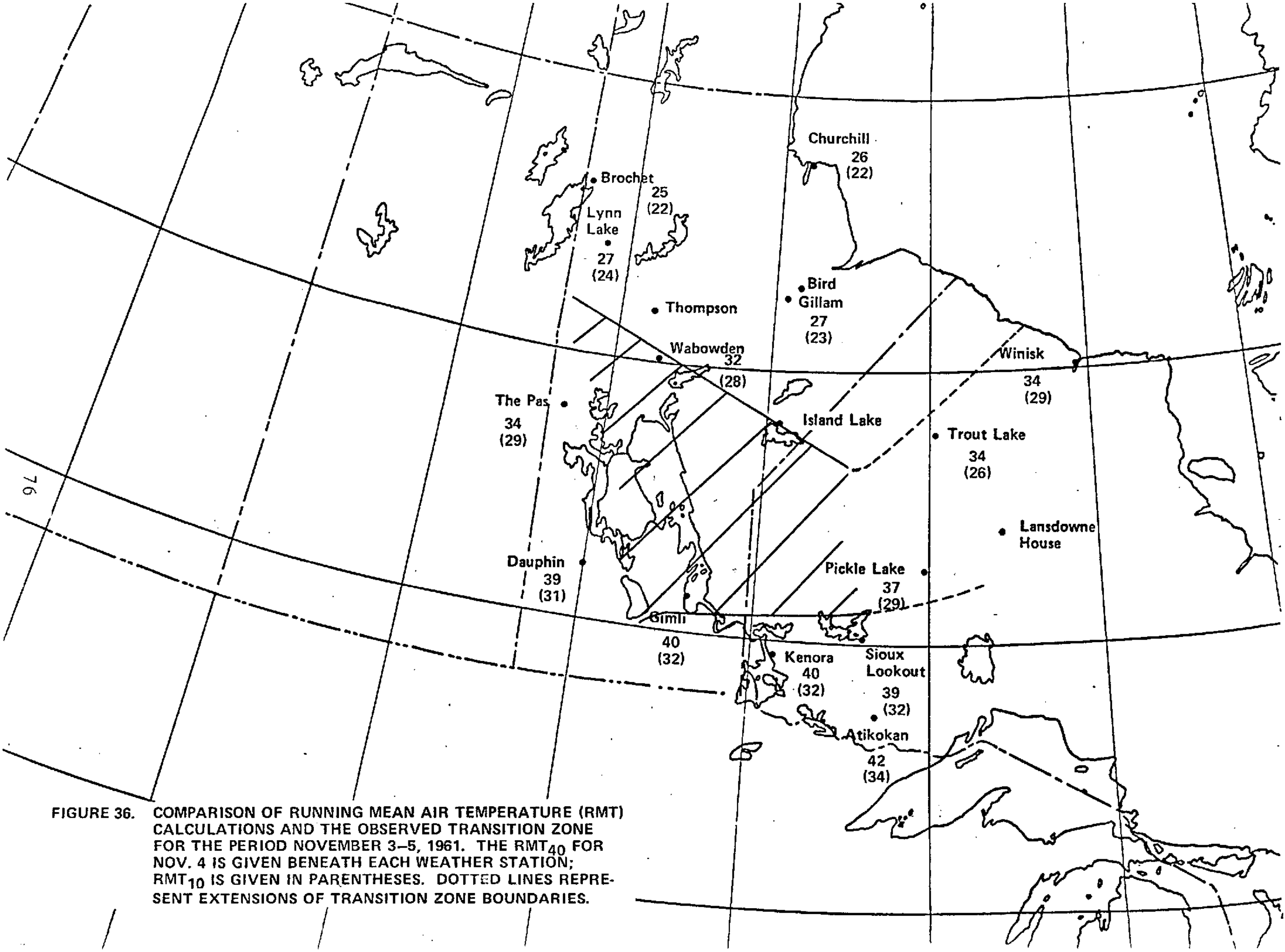

FIGURE 36. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD NOVEMBER 3–5, 1961. THE RMT_{40} FOR NOV. 4 IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES. DOTTED LINES REPRESENT EXTENSIONS OF TRANSITION ZONE BOUNDARIES.

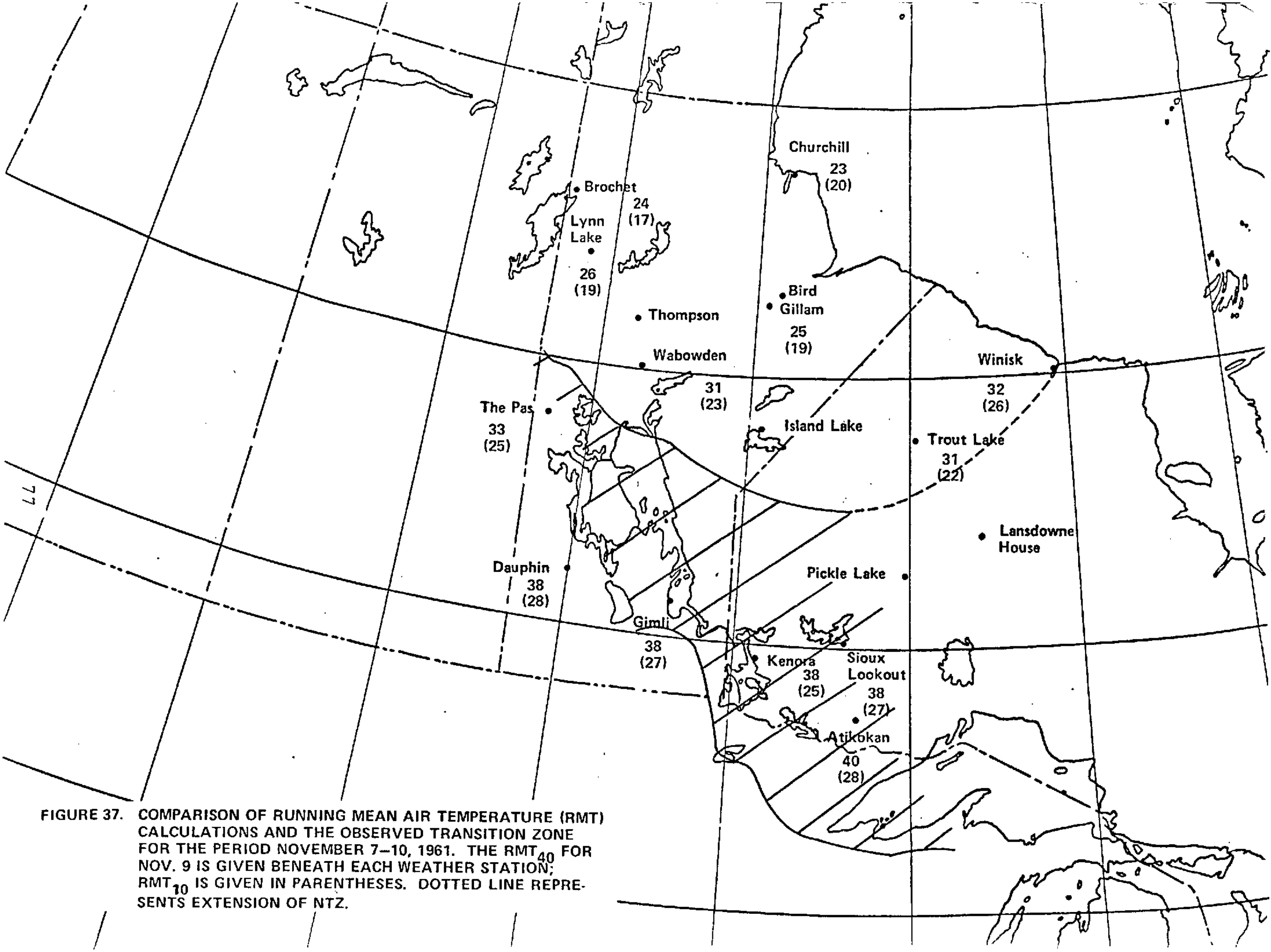

FIGURE 37. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD NOVEMBER 7–10, 1961. THE RMT_{40} FOR NOV. 9 IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES. DOTTED LINE REPRESENTS EXTENSION OF NTZ.

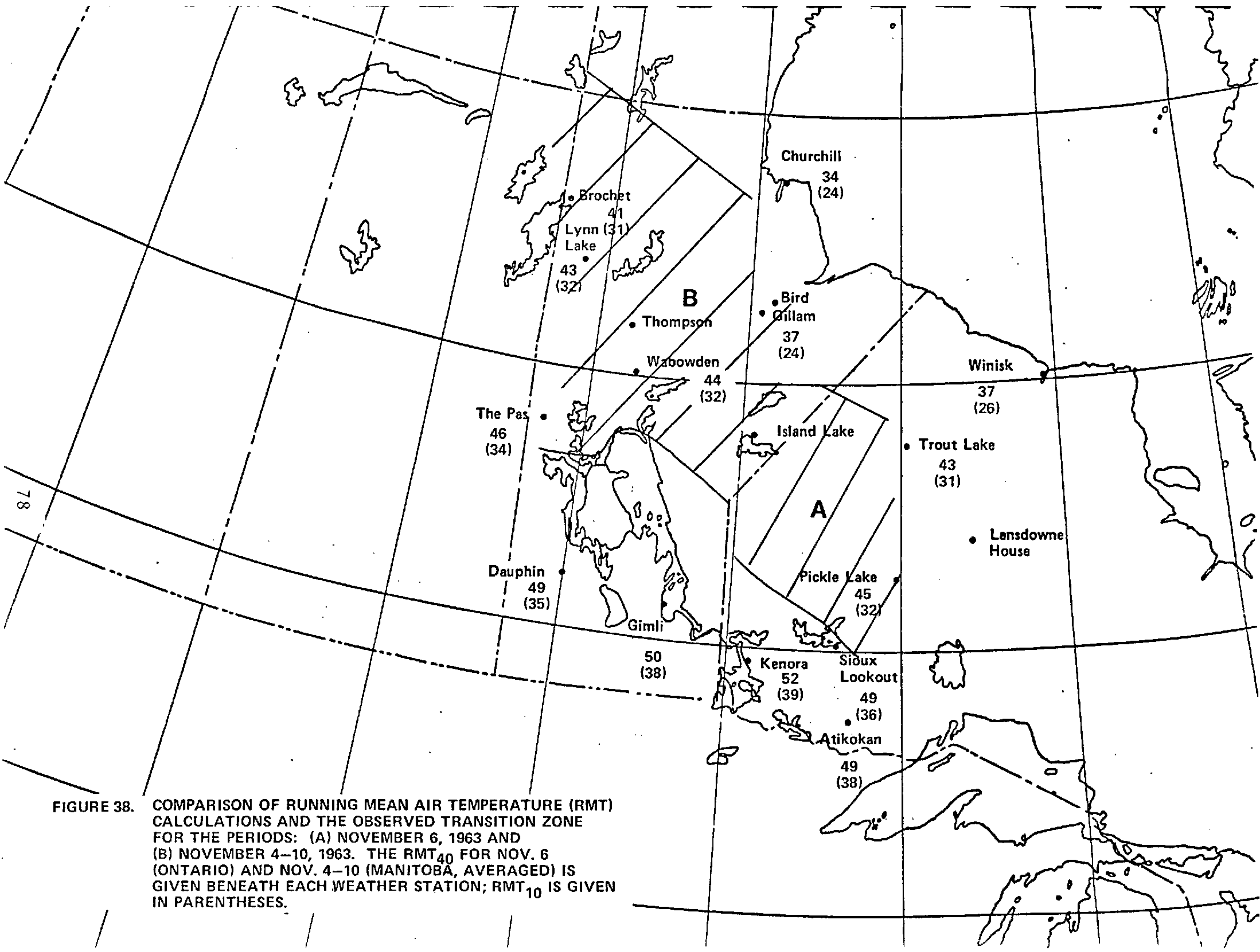

FIGURE 38. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIODS: (A) NOVEMBER 6, 1963 AND (B) NOVEMBER 4–10, 1963. THE RMT_{40} FOR NOV. 6 (ONTARIO) AND NOV. 4–10 (MANITOBA, AVERAGED) IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES.

close to either transition zone boundary (e.g., Lynn Lake and The Pas in Figure 35) have running mean temperatures at exactly the freezing temperature. The fit is so good, that one is tempted to extend the transition zone solely on the basis of RMT calculations. It should be noted, however, that McFadden's criterion resulted from his observations of the transition zone; in large part this accounts for the goodness of fit.

Despite the simplicity and accuracy of the RMT method for locating the transition zone in space and time, the computational base period may vary from year to year. For example, in 1963 (Figure 38) the RMT_{40} and RMT_{10} defined the NTZ and STZ much less well than they did in 1961; a transition zone drawn solely on the basis of RMT_{40} and RMT_{10} would differ considerably from the observed transition zone for the same period. As has been noted previously, the 1961 and 1963 freeze seasons differed appreciably in temperature.

The annual variation in the RMT base period is again obvious for the results from 1972 (Figures 39-40). As in the case of 1963, these latest results provide a less than optimum fit to McFadden's criterion; the transition zone for mid-November 1972 (Figure 40) is most incongruous of all.

Only a moderate effort is required to adjust the RMT base period (n) and produce results that better fit each observed transition zone. Such "tuning" of McFadden's criterion would only have value if (1) the adjusted RMT base period was applicable over the entire freeze season and/or (2) a relationship was discovered between the base period and the general climatology of each freeze season. That is, the transition zone could be accurately predicted in space and time, if the appropriate RMT base period was known a priori.

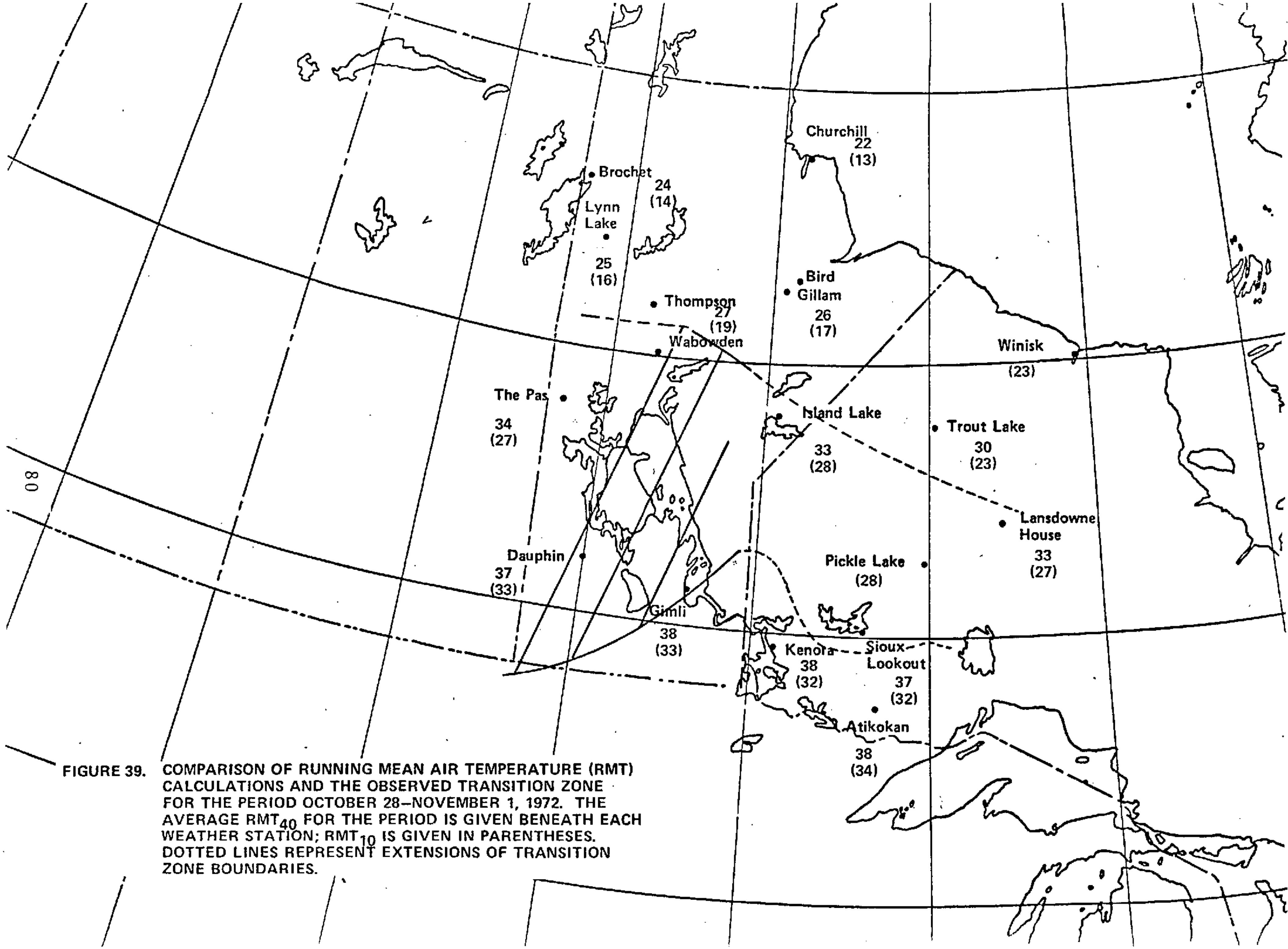

FIGURE 39. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD OCTOBER 28–NOVEMBER 1, 1972. THE AVERAGE RMT_{40} FOR THE PERIOD IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES. DOTTED LINES REPRESENT EXTENSIONS OF TRANSITION ZONE BOUNDARIES.

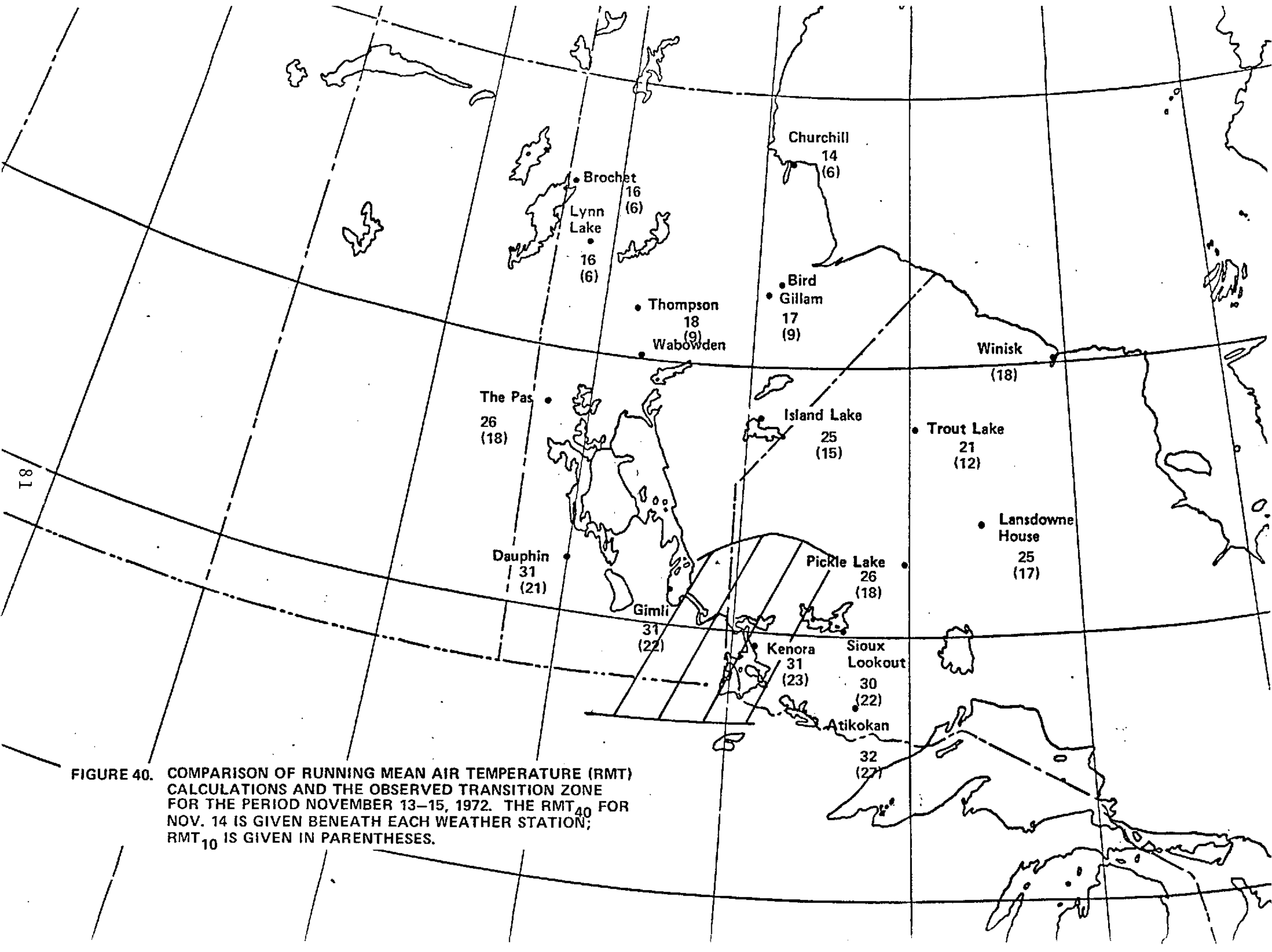

FIGURE 40. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD NOVEMBER 13–15, 1972. THE RMT_{40} FOR NOV. 14 IS GIVEN BENEATH EACH WEATHER STATION; RMT_{10} IS GIVEN IN PARENTHESES.

An extensive analysis of "tuned" base periods as seasonally or annually varying functions of regional climatology was not attempted in this investigation. Future efforts along this line of research are recommended. In the meantime, McFadden's criterion is an acceptable means of placing the freeze transition zone.

3.3.2 Running Mean Temperature - Thaw Season

The corollary of McFadden's criterion for the thaw season states that deep lakes lose their ice cover very close to the intersection date of the 40-day RMT and the temperature of maximum water density (4°C/39°F), whereas shallow lakes thaw out at about the time the 3-day running mean temperature reaches the temperature of maximum water density. In actuality, McFadden uses 5°C as the deicing temperature, but gives no justification for this selection. The reason the freezing temperature (0°C/32°F) is not used has to do with the physics of lake ice melting which largely occurs at the ice-water interface. Since the process is well understood, it is not discussed here.

A comparison of a thaw transition zone observation for 1963 [12], and calculated running mean temperatures is shown in Figure 41. In addition to the observed TZ, dashed lines have been added to indicate TZ boundaries based solely on RMT data. Note that if McFadden's thaw criterion holds, the NTZ should coincide with the RMT_{10} 39°F isotherm, while the STZ should coincide with the RMT_{40} 39°F isotherm. The agreement is excellent, within the constraints of available information.

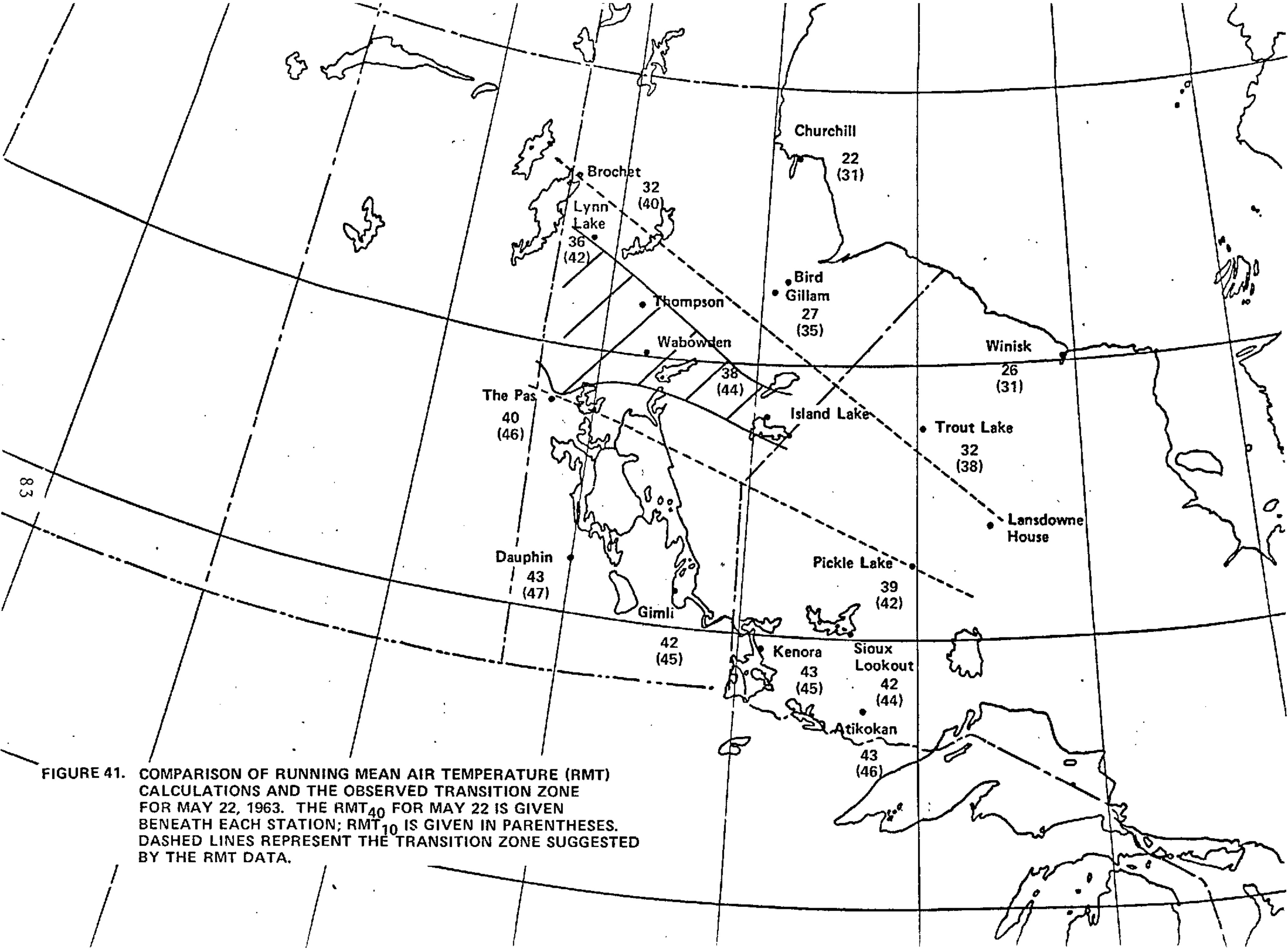

FIGURE 41. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR MAY 22, 1963. THE RMT_{40} FOR MAY 22 IS GIVEN BENEATH EACH STATION; RMT_{10} IS GIVEN IN PARENTHESES. DASHED LINES REPRESENT THE TRANSITION ZONE SUGGESTED BY THE RMT DATA.

The real test of McFadden's thaw criterion is the 1973 thaw season, the results for which are shown in Figures 42-45. The break-up dates for lakes located within the TZ have also been included for comparative purposes. Within the uncertainty inherent in positioning the transition zone, the agreement is good. Two obvious exceptions are the stations Dauphin and Gimli in Figures 42-44. In both these cases the RMT values were consistently below what they should have been relative to the location of the transition zone. To a certain degree this anomaly reflects an unusually cold mid-April in southern Manitoba (Figure 43), the duration of which was too brief to radically affect the transition zone. Be that as it may, the results suggest that the thaw criterion should be applied with care.

3.3.3 RMT Prediction Method

Despite some minor inconsistencies, the great bulk of data indicate that the running mean temperature calculation is a fairly accurate means of predicting the passage of the lake transition zone during both freezing and thawing periods. What's more, if the "deep" lakes of a region are distinguishable from the "shallow" lakes, the freezing and thawing dates of all lakes can be estimated within the accuracy of extended weather forecasts. The RMT prediction method, embodied in McFadden's criteria, is a viable means of locating the transition zone throughout the ice year.

3.4 LAKE MEAN DEPTH EVALUATION

An important limnological objective of this investigation was to estimate the approximate mean depths of lakes on the basis of their relative freeze dates. Since lakes freeze by giving up heat from their water mass to the atmosphere,

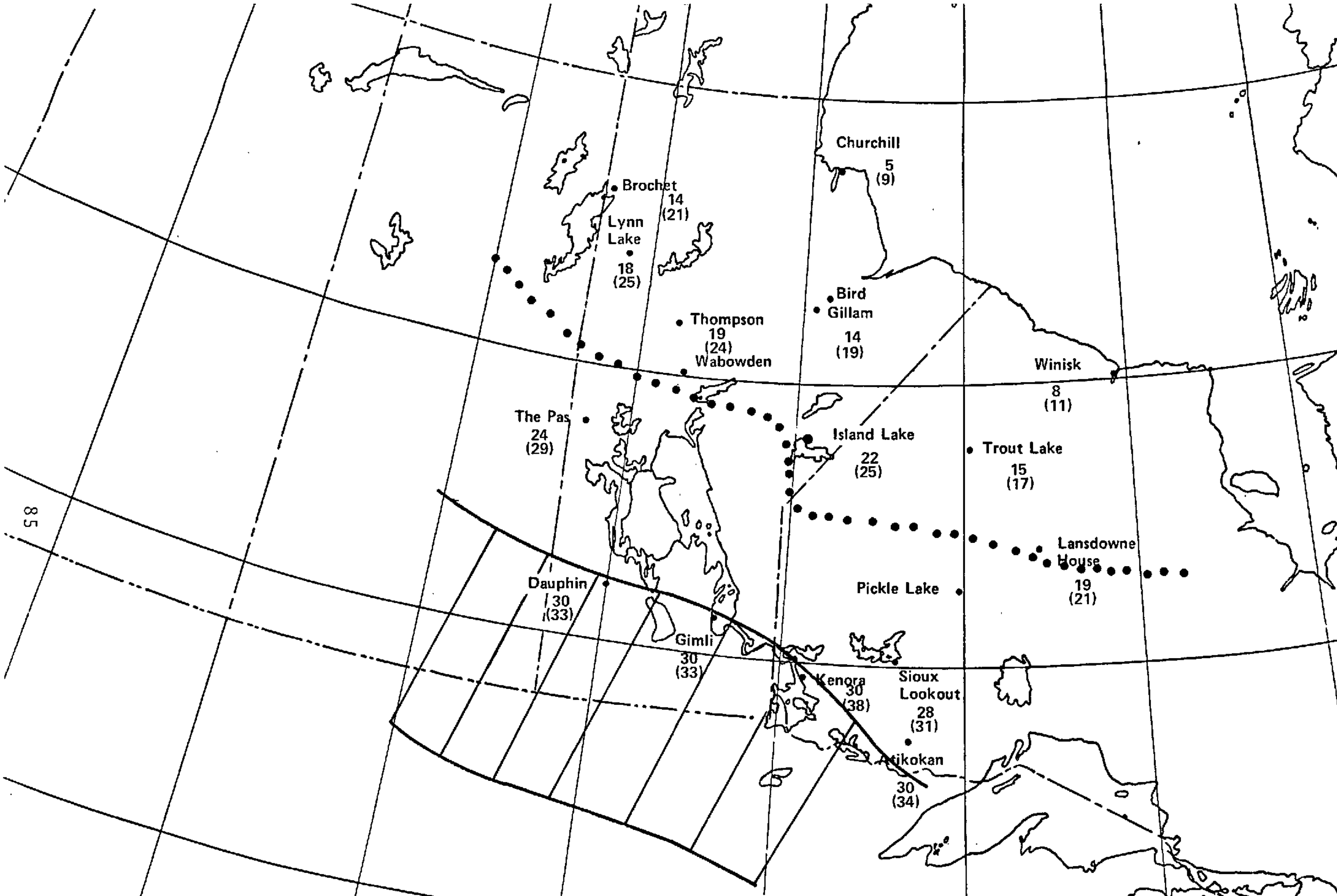

FIGURE 42. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD APRIL 4–10, 1973. THE DOTTED LINE REPRESENTS APPROXIMATE ICE DECAY BOUNDARY. THE RMT_{40}, AVERAGED OVER THE PERIOD IS GIVEN BENEATH EACH STATION; RMT_{10} IS GIVEN IN PARENTHESES.

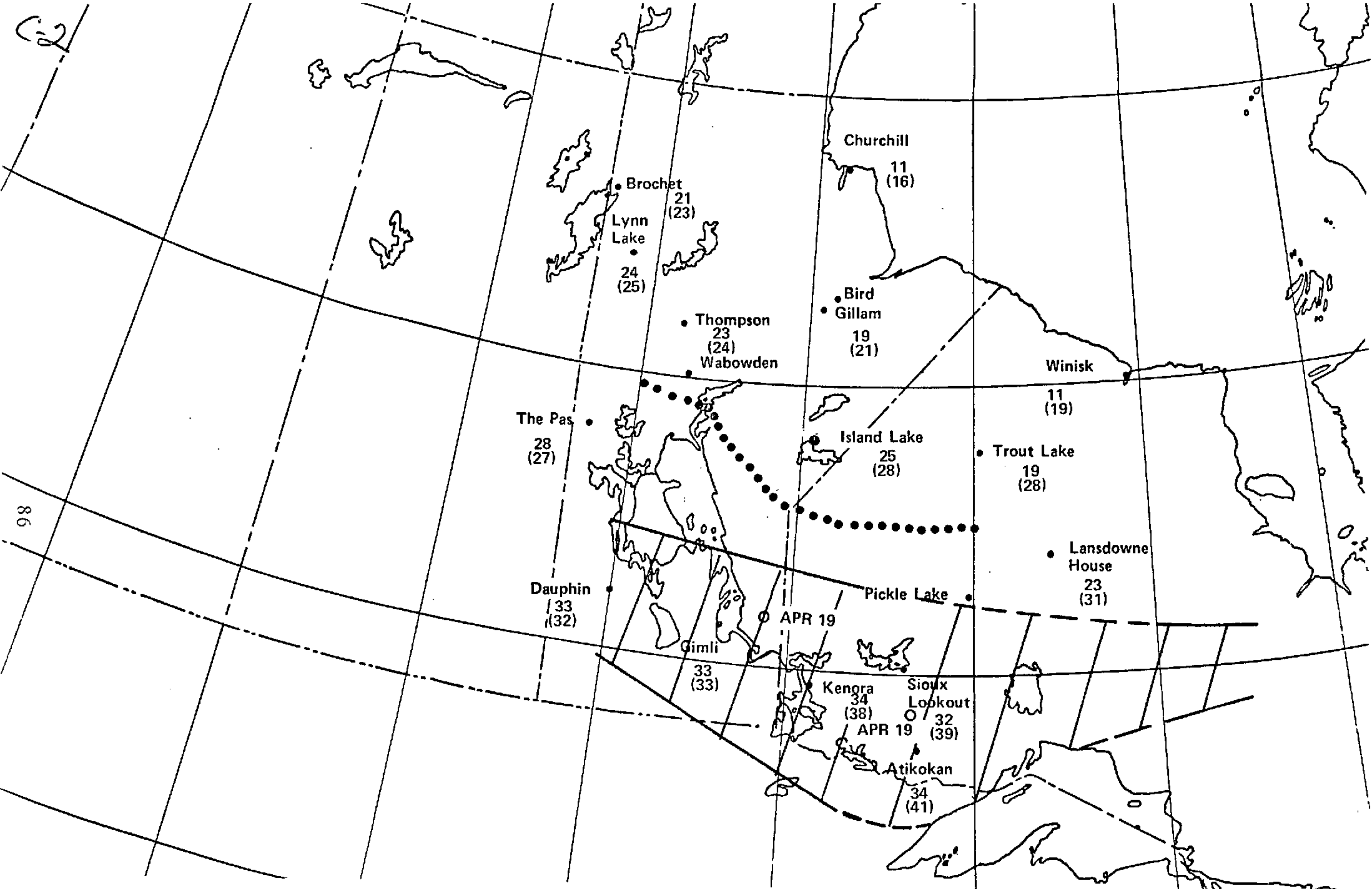

FIGURE 43. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD APRIL 23–27, 1973. THE DOTTED LINE REPRESENTS APPROXIMATE ICE DECAY BOUNDARY. THE DASHED LINES EXTRAPOLATE THE TRANSITION ZONE TO THE EAST. OPEN CIRCLES MARK LAKES WHOSE BREAKUP DATES ARE KNOWN. THE RMT_{40} AVERAGED OVER THE PERIOD IS GIVEN BENEATH EACH STATION; RMT_{10} IS GIVEN IN PARENTHESES.

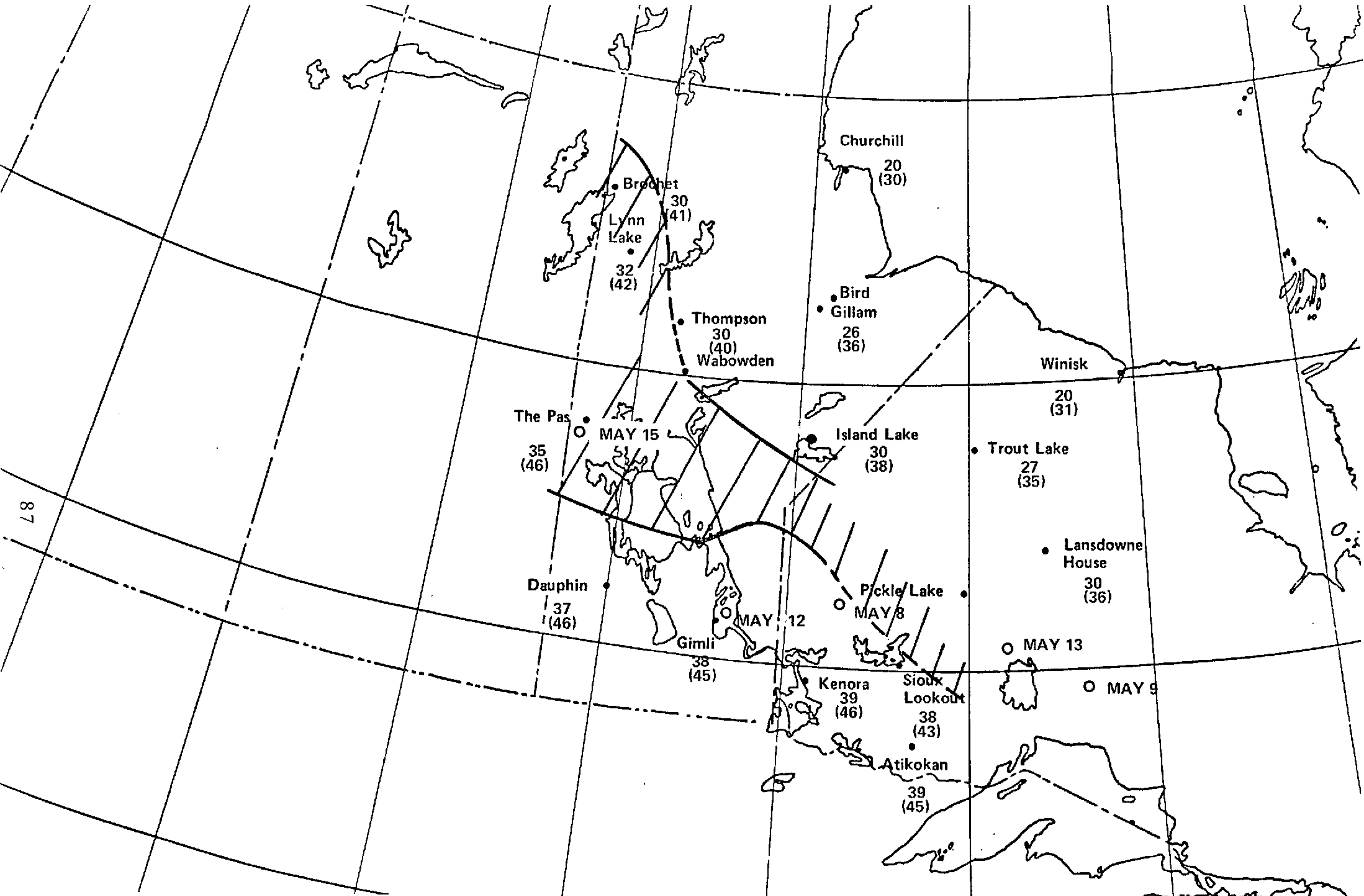

FIGURE 44. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD MAY 13–19, 1973. THE DASHED LINES REPRESENT KNOWN EXTRAPOLATIONS OF THE TRANSITION ZONE. OPEN CIRCLES MARK LAKES WHOSE BREAKUP DATES ARE KNOWN. THE RMT_{40} AVERAGED OVER THE PERIOD IS GIVEN BENEATH EACH STATION; RMT_{10} IS GIVEN IN PARENTHESES.

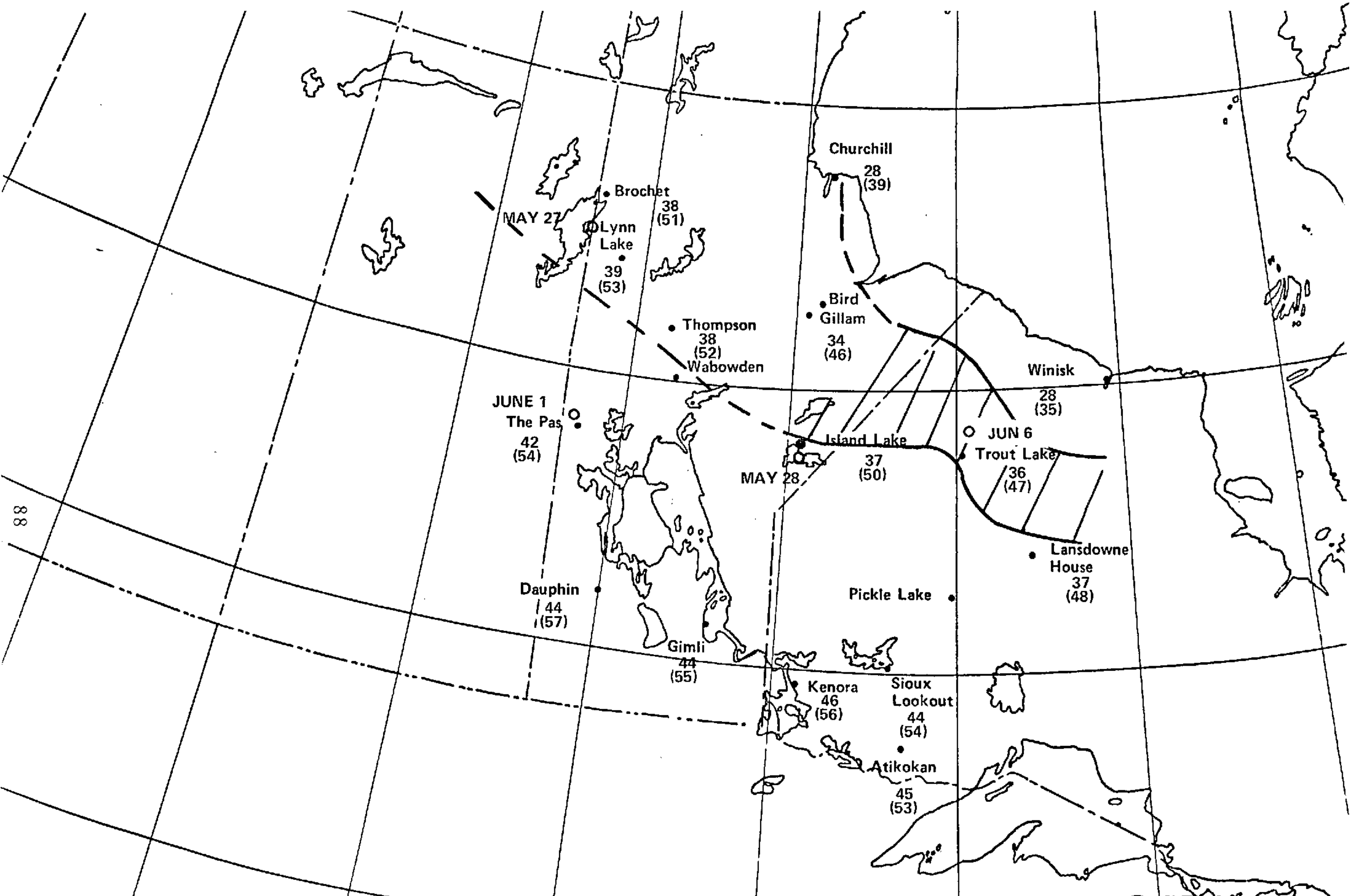

FIGURE 45. COMPARISON OF RUNNING MEAN AIR TEMPERATURE (RMT) CALCULATIONS AND THE OBSERVED TRANSITION ZONE FOR THE PERIOD MAY 26–29, 1973. THE DASHED LINES REPRESENT KNOWN EXTRAPOLATIONS OF THE TRANSITION ZONE. OPEN CIRCLES MARK LAKES WHOSE BREAKUP DATES ARE KNOWN. THE RMT_{40} AVERAGED OVER THE PERIOD IS GIVEN BENEATH EACH STATION; RMT_{10} IS GIVEN IN PARENTHESES.

lake freeze dates could function as a relative measure of water mass. The mean depth, defined as lake volume divided by surface area, can serve as the unit of water mass.

In order to investigate how freezing and thawing dates vary as a function of mean depth, the historical freezing and thawing data given in Appendix B were collected for lakes of known morphometry. This information was reduced; mean freeze and thaw dates were calculated for each lake with 4 or more observations. Plots of the resultant data as a function of latitude are shown in Figures 46-47; each lake is labeled with its mean depth in meters. As expected, mean freeze dates generally increase as latitude decreases (Figure 46), while mean thaw dates increase as latitude increases (Figure 47).

Morphometric dependencies become somewhat more pronounced after isopleths of constant mean depth are drawn. These demonstrate that a simple linear relationship between latitude, mean depth, and mean freeze date does not exist, at least within the accuracy of the available data. However, longitudinal effects, which are known to occur, as well as temporal variations, have been largely neglected in this simplistic analysis.

The influence of mean depth in regulating the freezing date is nicely demonstrated by a group of Wisconsin lakes clustered about 43°N latitude (Figure 46). The analogous tendency for deeper lakes to react more slowly in thawing than nearby shallow lakes is shown by the same lakes (Figure 47), but the influence is less pronounced. Be that as it may, the consistencies suggest that a generic relationship between lake ice milestones and mean depth can be developed.

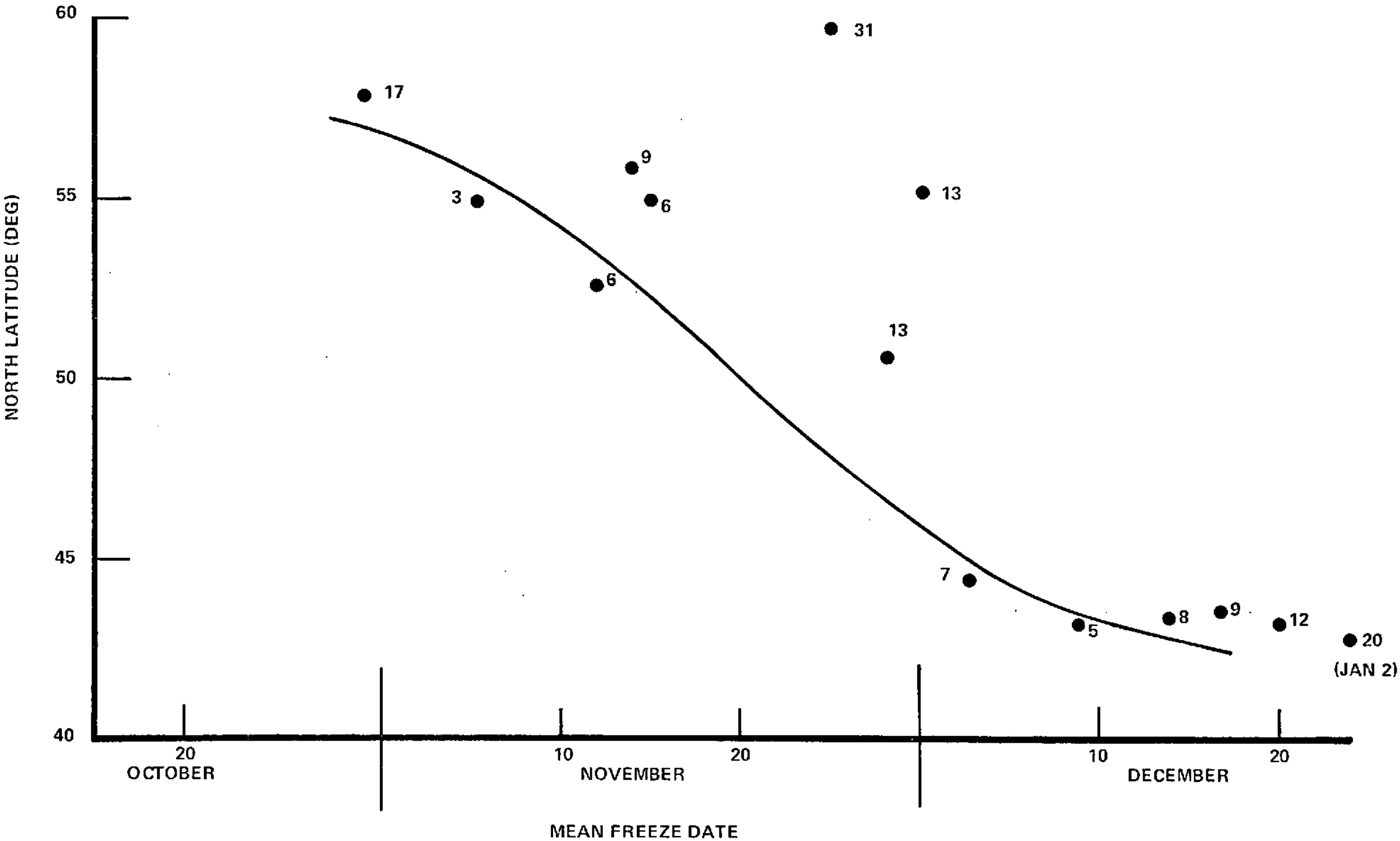

FIGURE 46. LAKE MEAN DEPTH VARIATION AS A FUNCTION OF LATITUDE AND MEAN FREEZE DATE. ONLY LAKES WITH FOUR OR MORE FREEZE OBSERVATIONS USED. NUMBERS ON FIGURE INDICATE LAKE MEAN DEPTH; "DEEP" LAKE ISOPLETH DRAWN.

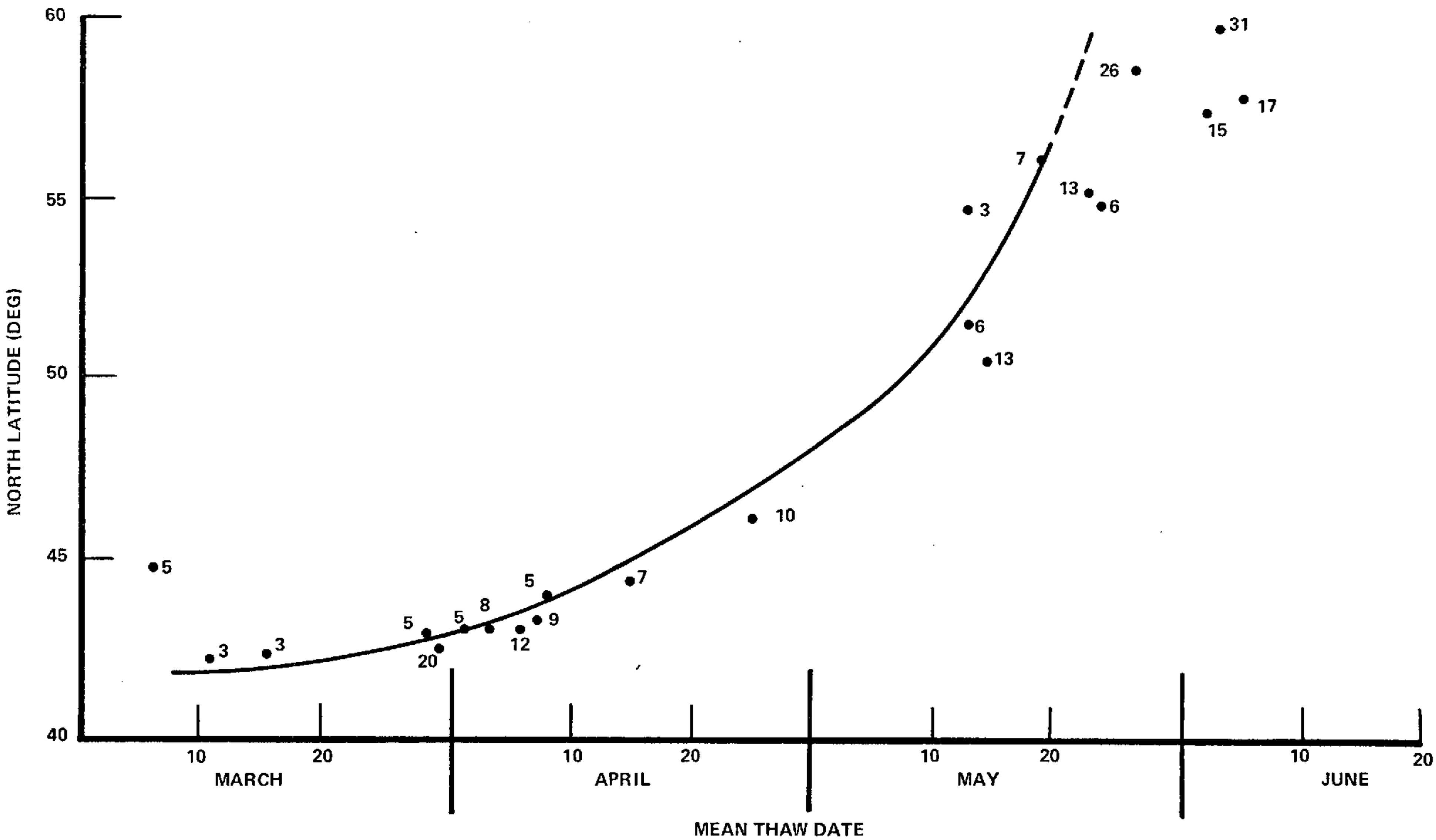

FIGURE 47. LAKE MEAN DEPTH VARIATION AS A FUNCTION LATITUDE AND MEAN THAW DATE. ONLY LAKE WITH FOUR OR MORE BREAKUP OBSERVATIONS USED. NUMBERS ON FIGURE INDICATE LAKE MEAN DEPTH; "DEEP" LAKE ISOPLETH DRAWN.

A first step in estimating lake mean depth according to its freezing and/or thawing date is indicated by the "deep" lake contour in Figures 46 and 47. As an example, any lake at 50°N latitude that became ice covered in early November would be classified as a "shallow" lake. This technique is admittedly crude, however, if a family of curves can be drawn relating freeze date to mean depth, the utility of ERTS as a hydrographic survey tool would be greatly enhanced. Large, uncharted lake groups might be initially surveyed by satellite on the basis of their relative freezing dates.

SECTION 4.0
CONCLUSIONS

The introduction to this report identified five objectives which this investigation sought to accomplish. On the basis of the results reported in the previous section, the extent to which those objectives were fulfilled can now be addressed.

1. Perform a Lake Ice Survey

The conduct of a lake ice survey was shown to be impractical using ERTS. That is, the 18-day repeat cycle of the satellite is too long to permit a meaningful determination of ice state during the critical freezing and thawing periods. The viewing of a given lake on a daily basis is the optimum repeat frequency for performing a lake ice survey.

2. Map the Migration of the Lake Transition Zone

With its large viewing area and synoptic coverage ERTS was ideally suited to observe the lake transition zone on a regular, repetitive basis. To the extent permitted by cloud cover the transition zone was tracked for the entire 1972 ice year. To the author's knowledge this was the first time that the complete evolution of the transition zone had been documented in central North America or anywhere else.

3. Correlate the Transition Zone and its Movements with Regional Climatic Effects

In essence this objective was the heart of the investigation, and a number of noteworthy findings were made. First, the transition zone for the 1972 ice year was consistently oriented in a northwest-southeast direction throughout both the freeze and thaw seasons regardless of latitude. This orientation was attributed to the dominant atmospheric flow patterns over that part of the continent, and it reflected the influence of regional climate on freezing and thawing trends in lakes. The unidirectional orientation of the transition zone has been corroborated by other investigators, suggesting that it is probably a recurring feature of the zone.

Conversely the transition zone appeared to influence the distribution of regional weather patterns, at least during the freeze season. High pressure centers of polar continental air failed to cross the transition zone. On the other hand, low pressure centers tended to originate in and/or travel along the trend of the transition zone, and the meteorological evidence suggests that the cyclones intensified significantly during their tenure in the zone. Finally, intensely cold anticyclones of arctic origin, polar outbreak highs, appeared to be totally unaffected by the transition zone.

Analogous climatic interactions were not apparent during the thaw season. However, this result is to be expected if heat and water vapor contributed by the lakes were principal factors affecting the atmosphere over the transition zone. Lakes act as heat absorbers after thawing and would have little capacity to interfere with the flow of air in their vicinity. On the other hand, before freezing lakes cool rapidly through the transfer of latent and sensible heat to the atmosphere. The concentrated releases of large amounts of heat and water vapor by the numerous lakes of central Canada were probably responsible for the convective instability over the transition zone observed by Ragotzkie and McFadden [11]. These same heat and mass transfer phenomena may also have been responsible for influencing the flow of air masses relative to the transition zone.

4. Develop a Technique for Predicting the Freezing and Thawing of Lakes

The objective had already been achieved in part by McFadden [12]. This study was able to affirm the applicability of McFadden's relationships and extend them to predicting the location of the transition zone solely on the basis of running mean air temperature (RMT) calculations. A general statement of the predictive model would be:

- Freeze Season - "deep" lakes freeze when the 40-day RMT reaches the freezing temperature (0°C), and "shallow" lakes freeze when the 10-day RMT reaches the freezing temperature;

- Thaw Season - "deep" lakes thaw (breakup) when the 40-day RMT reaches the temperature of maximum water density (4°C), and "shallow" lakes thaw when the 10-day RMT reaches the temperature of maximum water density.

According to McFadden, lakes whose mean depths exceed 6 meters are "deep", whereas those with mean depths less than 6 meters are "shallow."

The model was successfully tested against transition zone observations for the 1961, 1963, and 1972 ice years. As a result, not only can the freeze and thaw dates of "deep" and "shallow" lakes be predicted on the basis of weather forecasts, but the passage of the transition zone can be estimated as well. These findings do not eliminate ERTS as a tool for making lake ice observations; accurate forecasts of air temperature are not possible beyond more than a few days. The model has greater value as a retrospective means of locating the transition zone for climatic analyses.

5. <u>Estimate the Mean Depths of Lakes on the Basis of their Freezing Sequence</u>

This objective was not achievable because it depended on a successful conclusion to objective one, the lake ice survey. Since the exact freezing dates of individual lakes were indeterminate from the ERTS imagery, correlations with their mean depths were impossible. However, background information on many lakes in the form of freeze/thaw histories and morphometric data was utilized to derive crude relationships between average freeze/thaw date, mean depth, and latitude. The relationships suggest that on the basis of the icing or breakup date of a certain lake, the mean depth can be estimated. This, in effect, fulfills the stated objective.

In summary, the results of this investigation assert the value of ERTS as a data collection platform for making lake ice observations. Granted certain types of observations (e.g., ice surveys) are best handled in conjunction with an active ground truth program, but this is typically the case with most remote sensing applications. The transition zone observations were made totally without benefit of ground truth, and their extensive spatial and temporal coverages are unique to ERTS. The ERTS system has demonstrated a superior potential for supporting studies dealing with the lake ice transition zone and associated hydrometeorological phenomena.

SECTION 5.0
RECOMMENDATIONS

As with any investigation for which some positive results are achieved, the need or desirability of additional work becomes evident by the degree of certainty with which the findings can be stated.

This work has produced some reasonable, yet still inconclusive, correlations between the lake freeze transition zone and regional climatology. The correlations are inconclusive only in that they strictly apply just to the 1972 freeze season. In order to substantiate that the transition zone does indeed influence the weather in its vicinity, at least one other ice year should be examined. The 1973 or 1974 ice years are prime candidates because of the availability of ERTS coverage.

The interdependence of lake ice and climate should be manifest by variations in numerous meteorological parameters: temperature, wind vector, precipitation, barometric pressure, cloud cover. Thus far only temperature has received what could be characterized as detailed analytical study. A closer examination of meteorological parameters and their sensitivity to the transition zone - beyond what has been attempted here - is a recommended course of action that would seem to have a good potential for being fruitful. In particular, the thaw season should receive the detailed scrutiny which the constraints of time and resources prevented during this investigation.

Should the interactive effects of lake ice and climate eventually become established and predictable, they would enable weather forecasts in central North America to be greatly improved, as well as contribute to our overall knowledge of earth-atmosphere coupling.

SECTION 6.0
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PLATES 1 AND 2

Multispectral Scanner (MSS) views of the same ERTS-1 scene taken just south of Reindeer Lake, Saskatchewan on May 3, 1973. Plate 1 shows the MSS band 7 image; terrestrial features are subdued, but the open waters of the Reindeer River are readily apparent. Plate 2 is the identical scene in MSS band 5; the highly reflective ice-covered surfaces of the numerous small lakes of the region stand out in this image. The contrasting images illustrate the value of band 5 for detecting ice-covered lakes.

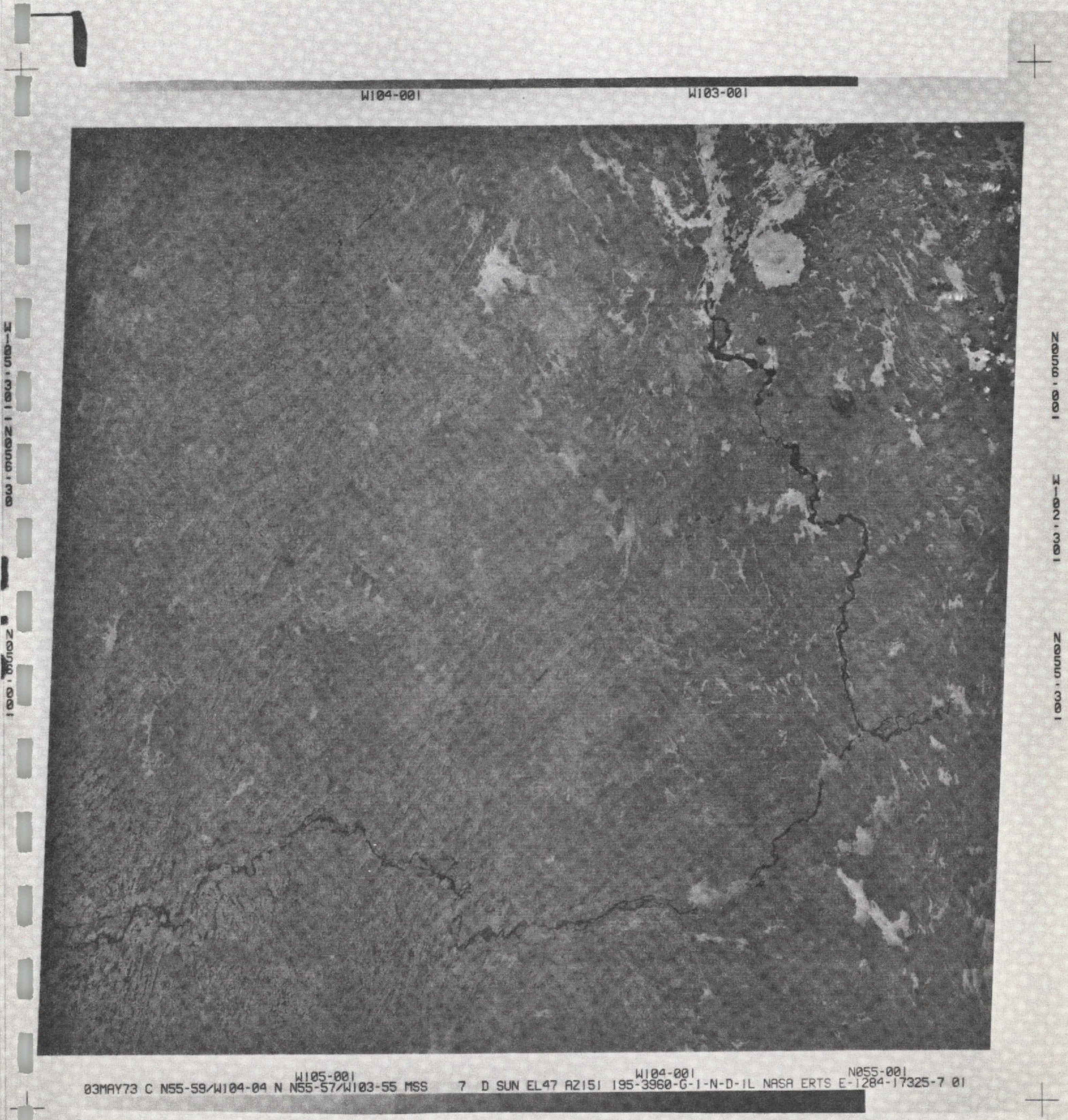

PLATE 1

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PLATE 3

A view of the thaw transition zone in southern Saskatchewan on March 29, 1973. The South Saskatchewan River flows from south to north in the right-hand portion of the scene; the ice-covered reservoir created by the South Saskatchewan River Dam is well displayed in the lower right-hand corner, and the City of Saskatoon can just be discerned in the upper right-hand corner where the river ice disappears.

Numerous ice-covered, partially ice-covered, and ice-free lakes can be distinguished in the scene. The contrasting lake ice conditions are enhanced by a recent snowfall covering the southern half of the image.

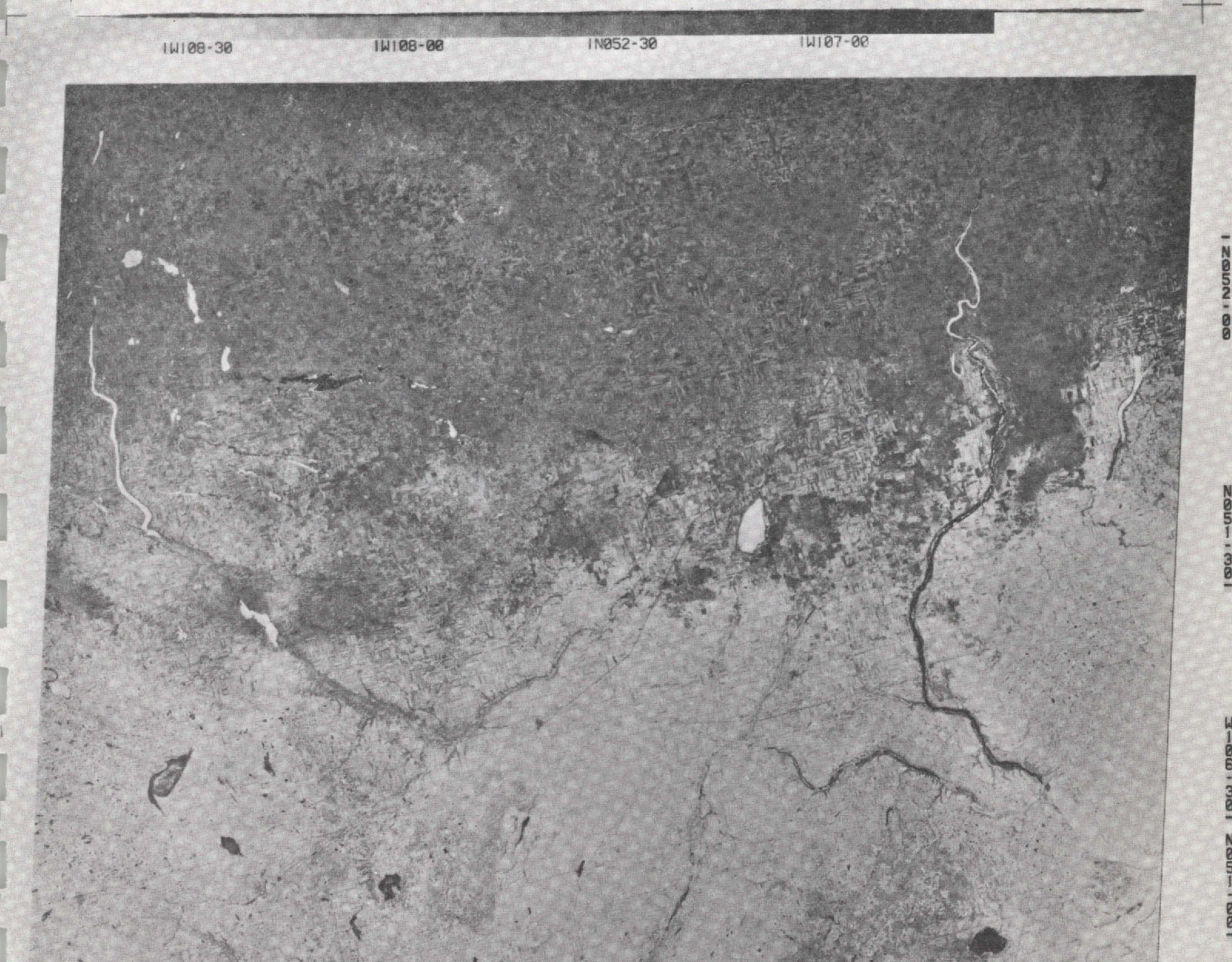

PLATE 3

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PLATE 4

A view of the thaw transition zone in southern Saskatchewan on March 30, 1973. This plate is a consecutive day image of the same scene shown in Plate 3 with approximately 40% sidelap. Many tiny, ice free lakes are apparent along the trend of the previous day's snowfall. A comparison of the two plates reveals that a considerable amount of snow melting had occurred during the 24-hour period. Note that the percentage of ice-covered lakes increases to the north, and that in general only the larger lakes are ice-covered to the south.

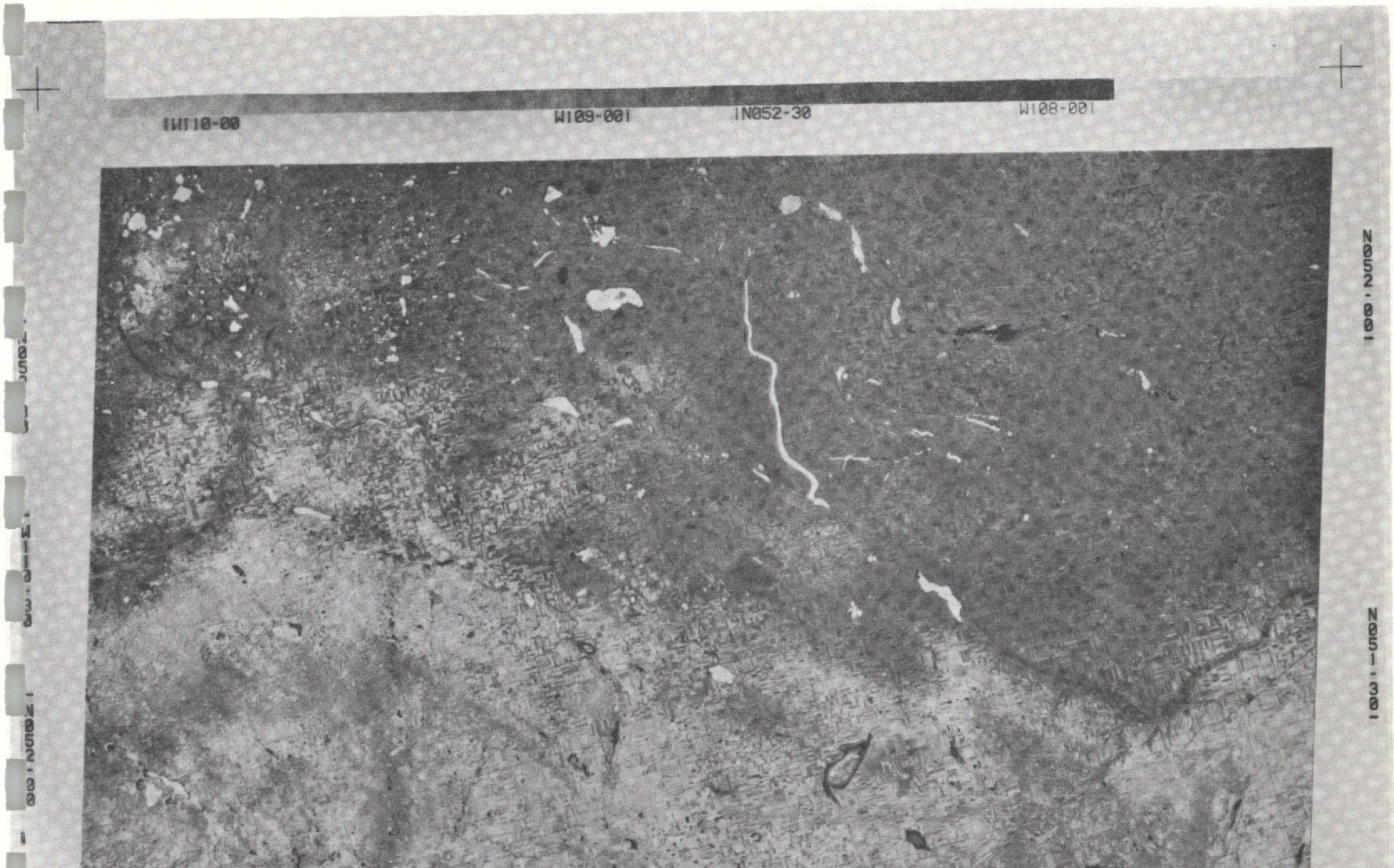

PLATE 4

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PLATE 5

A view of the freeze transition zone in southwestern Ontario on December 1, 1972. Recently frozen Lake of the Woods is visible in the bottom-left of the image. The few ice-free lakes in the bottom half of the scene are quite apparent in this MSS band 7 image. These lakes comprise the northern transition zone boundary for that date.

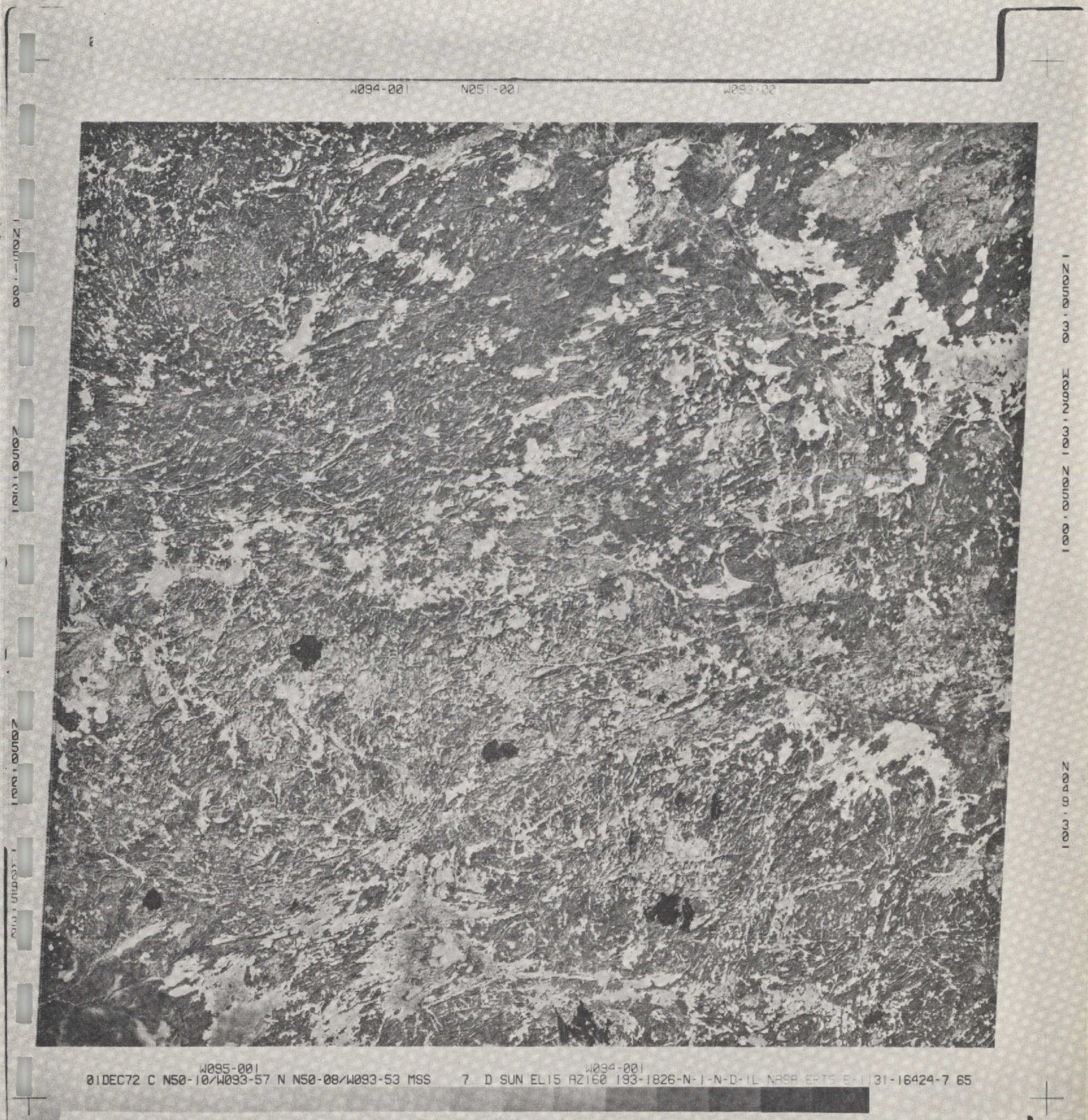

PLATE 5

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APPENDIX A
SURVEY LAKE DIRECTORY

LAKE DIRECTORY FILE CONTENTS FROM UPDATED TAPE T05962

	LAKE NAME	ID CODE	S/P	LATITUDE	LONGITUDE
1	BAKER	010034	NWT	6412	9530
2	UN-NAMED	010054	NWT	6845	10904
3	DOG POND	010065	NWT	6320	9043
4	MISSION	010074	NWT	6320	9043
5	POLICE	010085	NWT	6320	9043
6	UN-NAMED	010095	NWT	6912	11838
7	UN-NAMED (2)	010104	NWT	6935	12045
8	CONTWOYTO	010114	NWT	6529	11022
9	ENNADAI	010124	NWT	6108	10055
10	GREATSLAVE/MCLOU	010134	NWT	6243	10906
11	GREATSLAVE/CHARL	010144	NWT	6243	10906
12	GREATSLAVE/RESO	010154	NWT	6111	11341
13	UN-NAMED	010164	NWT	6840	9748
14	UN-NAMED	010194	NWT	6839	10144
15	MODULE	010214	NWT	6830	11313
16	BAGNELL	010224	NWT	6818	8541
17	LAKE BARROW	010254	NWT	6826	8939
18	GREAT BEAR	010264	NWT	6605	11802
19	UN-NAMED	010275	NWT	6835	11106
20	UN-NAMED	010304	NWT	6849	9325
21	FRAME	010324	NWT	6228	11427
22	LONG	010334	NWT	6228	11427
23	BRACKETT	010340	NWT	6523	12520
24	STEWART	010350	NWT	6424	12518
25	DARBY	010360	NWT	6749	9240
26	JACQUES	010370	NWT	6610	12725
27	BEAVERHILL	010380		6248	10422
28	PILOT	010390	NWT	6016	11100
29	PEERLESS	010400	NWT	5640	11442
30	BULMER	010410	NWT	6248	12045
31	TROUT	010420	NWT	6035	12110
32	STE THERESE	010430	NWT	6438	12135
33	UNNAMED	010440	NWT	6854	12110
34	MAUNOIR	010450	NWT	6730	12500
35	BELOT	010460	NWT	6655	12618
36	COLVILLE	010470	NWT	6710	12600
37	DES BOIS	010480	NWT	6650	12518
38	CANSO	010490	NWT	6733	12705
39	AUBRY	010500	NWT	6710	12600
40	YECTED	010510	NWT	6655	12923
41	LOON	010520	NWT	6637	12840
42	TAKIYJAK	010530	NWT	6616	11320
43	KAKISA	010540	NWT	6053	11733
44	TATHLINA	010550	NWT	6033	11730
45	BUFFALO	010560	NWT	6014	11525
46	MARA	010570	NWT	6525	10900
47	REBECCA	010580	NWT	6433	11622
48	INGRAY	010590	NWT	6417	11606
49	HOTTAH	010600	NWT	6505	11830
50	KAGLIK	010610	NWT	6926	12952
51	COLD	020014	ALB	5425	11017
52	ATHABASCA	020044	ALB	5843	11109
53	BEAR	020054	ALB	5511	11853
54	LAC LA BICHE	020064	ALB	5446	11158
55	LESSER SLAVE	020074	ALB	5521	11459

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	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
56	LAKE MINNEWANKA	020084	ALB	5111	11534
57	GLENMORE RESERVO	020094	ALB	5106	11401
58	NEWELL	020100	ALB	5026	11157
59	WOLF	020110	ALB	5441	11058
60	WINEFRED	020120	ALB	5530	11030
61	MOOSE	020130	ALB	5415	11055
62	CHIP	020140	ALB	5340	11525
63	FROBISHER	030011	SAS	5619	10757
64	JAN	030041	SAS	5455	10255
65	MIROND	030051	SAS	5507	10247
66	PELICAN	030061	SAS	5509	10300
67	MC INTOSH	030071	SAS	5550	10500
68	WILDNEST	030101	SAS	5500	10220
69	ANNABEL	030151	SAS	5450	10213
70	JOHNSON	030181	SAS	5451	10217
71	TYRELL	030191	SAS	5453	10208
72	CONTACT	030231	SAS	5613	10343
73	WOLLASTON	030351	SAS	5815	10320
74	AMISK	030361	SAS	5433	10215
75	BIG PETER POND	030371	SAS	5600	10850
76	LITTLE PETER PON	030381	SAS	5547	10835
77	ILE A LA CROSSE	030391	SAS	5527	10750
78	EKAPO	030414	SAS	5023	10235
79	CHURCHILL	030422	SAS	5551	10827
80	CREE	030432	SAS	5721	10650
81	LAC LA RONGE	030442	SAS	5508	10520
82	MEADOW	030454	SAS	5407	10826
83	WASCANA	030464	SAS	5026	10440
84	BEAVERLODGE	030472	SAS	5934	10829
85	BIG QUILL	030484	SAS	5146	10412
86	YORK	030494	SAS	5116	10225
87	REINDEER	030501	SAS	5720	10220
88	DEEP BAY	030510	SAS	5625	10300
89	JACKFISH	030520	SAS	5304	10824
90	CYPRESS	030530	SAS	4929	10930
91	RICHARDS	030540	SAS	5910	10710
92	CANOE	030555	SAS	5510	10815
93	PRIMROSE	030564	SAS	5455	10943
94	DAVY	030570	SAS	5852	10818
95	BASIN	030580	SAS	5237	10515
96	LAST MOUNTAIN	030590	SAS	5100	10514
97	KOHN	030600	SAS	5916	10229
98	GOOD SPIRIT	030610	SAS	5133	10240
99	CROOKED	030620	SAS	5036	10245
100	FARNSWORTH	040014	MAN	5845	9404
101	ATHAPAPUSKOW	040023	MAN	5437	10121
102	LAKE DAUPHIN	040043	MAN	5106	10003
103	SCHIST	040052	MAN	5441	10141
104	LAKE WINNIPEG	040082	MAN	5038	9703
105	HEMING	040093	MAN	5453	10107
106	LYNN	040102	MAN	5652	10104
107	ELDON	040112	MAN	5652	10104
108	LAKE MANITOBA	040123	MAN	5009	9830
109	LITTLE PLAYGREEN	040134	MAN	5359	9750
110	LAKE WAHTOPANAH	040144	MAN	5001	10019
111	CLEARWATER	040152	MAN	5402	10101
112	GRACE	040164	MAN	5350	10110
113	SETTING	040172	MAN	5455	9838

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
114	WINNIPEGOSIS	040183	MAN	5139	9955
115	BRERETON	040193	MAN	4954	9435
116	CADDY	040203	MAN	4949	9443
117	FALCON	040213	MAN	4942	9515
118	WEST HAWK	040223	MAN	4946	9511
119	BARRINGTON	040233	MAN	5656	10015
120	CEDAR	040243	MAN	5316	10009
121	CROSS	040253	MAN	5444	9730
122	GOOSE	040263	MAN	5423	10125
123	GRANVILLE	040273	MAN	5618	10030
124	ROCKY	040303	MAN	5409	10130
125	SOUTH INDIAN	040313	MAN	5720	9820
126	SPLIT	040323	MAN	5613	9617
127	WALKER	040333	MAN	5443	9700
128	WATERHEN	040343	MAN	5207	9935
129	WHEATCROFT	040353	MAN	5649	10101
130	WHITE	040373	MAN	5002	9533
131	ZED	040383	MAN	5655	10124
132	RICE	040394	MAN	5102	9540
133	REINDEER/BROCHET	040402	MAN	5753	10141
134	ISLAND	040414	MAN	5352	9440
135	MOLSON	040420	MAN	5413	9650
136	FILE	040430	MAN	5453	10023
137	KISKITTOGISU	040440	MAN	5410	9825
138	HERB	040450	MAN	5448	9952
139	AIKEN	040460	MAN	5113	9520
140	GOD'S	040470	MAN	5443	9408
141	RANDOLPH	050024	ONT	5017	8854
142	NYM	050034	ONT	4845	9137
143	PLATEAU	050044	ONT	4845	9137
144	STEEP ROCK	050054	ONT	4845	9137
145	LAKE KENOGAMISIS	050064	ONT	4941	8657
146	KENOGAMISIS/BART	050074	ONT	4941	8657
147	LAKE OF THE WOOD	050104	ONT	4948	9422
148	ATTAWAPISKAT	050114	ONT	5214	8753
149	PICKLE	050134	ONT	5127	9012
150	RED	050144	ONT	5104	9349
151	PELICAN	050164	ONT	5007	9154
152	BIG TROUT	050174	ONT	5350	8952
153	PICNIC	050204	ONT	4836	8517
154	TOOKENAY	050214	ONT	4836	8517
155	NIPIGON	050250	ONT	4950	8830
156	ECHOING	050260	ONT	5432	9217
157	LITTLE SACHIGO	050270	ONT	5410	9213
158	SACHIGO	050280	ONT	5349	9208
159	MAGISS	050290	ONT	5258	9140
160	WINDIGO	050300	ONT	5236	9135
161	TROUT	050310	ONT	5112	9320
162	WABIMIEG	050320	ONT	5128	8535
163	PLEDGER	050330	ONT	5053	8343
164	JOG	050340	ONT	5025	8522
165	NAGAGAMI	050350	ONT	4924	8500
166	WHITE	050360	ONT	4849	8538
167	SANDY BEACH	050370	ONT	4948	9222
168	SNOWDEN	050380	ONT	4932	9113
169	SYDNEY	050390	ONT	5049	9428
170	SILVER	050400	ONT	4953	9410
171	SENACHWINE	060041	ILL	4110	8921

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
172	GOOSE	060051	ILL	4114	8923
173	PISTAKEE	060061	ILL	4223	8812
174	HORSESHOE	060071	ILL	3842	9005
175	CHAUTAUQUA	060081	ILL	4022	9000
176	SPRING	060091	ILL	4202	9008
177	FOX	060101	ILL	4225	8809
178	CALUMET	060111	ILL	4140	8735
179	CLEAR	060141	ILL	4025	8957
180	VERMILLION	060151	ILL	4011	8738
181	WAWASEE	070021	IND	4124	8542
182	WINONA	070031	IND	4113	8550
183	CEDAR	070051	IND	4122	8726
184	SYRACUSE	070061	IND	4125	8544
185	SPIRIT	080031	IWA	4328	9505
186	MAC BRIDE	080051	IWA	4148	9134
187	CORALVILLE	080061	IWA	4143	9132
188	RED ROCK	080071	IWA	4122	9259
189	RATHBUN	080081	IWA	4050	9254
190	CLEAR	080090	IWA	4308	9325
191	STORM	080100	IWA	4237	9513
192	UNION	090071	MCH	4203	8512
193	BEAR	090103	MCH	4448	8437
194	BIG PORTAGE	090113	MCH	4219	8415
195	FINE	090133	MCH	4227	8517
196	MUSKEGON	090211	MCH	4314	8618
197	GOGEBIC	090220	MCH	4632	8935
198	HOUGHTON	090230	MCH	4420	8445
199	HIGGINS	090240	MCH	4429	8445
200	BIG STONE	100031	MIN	4519	9627
201	BUFFALO	100041	MIN	4510	9354
202	SHAGAWA	100051	MIN	4755	9154
203	MILLE LACS	100060	MIN	4615	9338
204	UPPER RED	100070	MIN	4807	9445
205	LAKE OF THE WOOD	100080	MIN	4900	9500
206	WINNIBIGOSHISH	100090	MIN	4727	9410
207	OTTER TAIL	100100	MIN	4624	9540
208	ALBERT LEA	100110	MIN	4338	9319
209	NETT	100120	MIN	4807	9307
210	PELICAN	100130	MIN	4804	9255
211	WILD RICE	100140	MIN	4654	9211
212	WACONIA	100150	MIN	4453	9347
213	SWAN	100160	MIN	4418	9415
214	LEECH	100170	MIN	4710	9422
215	HAGEN	110031	NEB	4220	9944
216	MOON	110041	NEB	4223	10008
217	WILLOW	110051	NEB	4214	10005
218	BIG ALKALI	110091	NEB	4238	10037
219	DADS	110111	NEB	4230	10040
220	MARSH	110151	NEB	4230	10030
221	PELICAN	110181	NEB	4232	10039
222	RED DEER	110201	NEB	4234	10029
223	SWAN	110211	NEB	4214	10046
224	TROUT	110221	NEB	4235	10037
225	CRESCENT	110251	NEB	4142	10224
226	GOOSE	110261	NEB	4147	10227
227	ISLAND	110281	NEB	4144	10224
228	GEORGE	110291	NEB	4159	10150
229	SWAN	110311	NEB	4143	10230

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
230	JOHNSON	110320	NEB	4042	9950
231	MALONEY RES	110330	NEB	4103	10047
232	SWANSON	110340	NEB	4010	10107
233	ASHTABULA	120011	NDA	4710	9800
234	SPIRITWOOD	120021	NDA	4711	9850
235	SAKAKAWEA	120031	NDA	4735	10125
236	HEART BUTTE	120051	NDA	4636	10150
237	JAMESTOWN	120061	NDA	4656	9842
238	MEDICINE	120071	NDA	4828	10425
239	BIG STONE	130011	SDA	4518	9628
240	LAKE HERMAN	130021	SDA	4400	9710
241	LAKE MADISON	130031	SDA	4357	9700
242	LAKE KAMPESKA	130041	SDA	4455	9712
243	LAKE POINSETT	130051	SDA	4434	9705
244	LAKE ANDES.	130061	SDA	4309	9830
245	LAKE OAHE	130071	SDA	4428	10030
246	LAKE SHARPE	130081	SDA	4348	9923
247	FRANCIS CASE	130091	SDA	4304	9835
248	LEWIS & CLARK	130101	SDA	4251	9730
249	SHADEHILL	130111	SDA	4545	10213
250	SWAN	130120	SDA	4518	9952
251	BEAVER DAM	140013	WIS	4330	8852
252	ARBOR VITAE	140023	WIS	4558	8939
253	CAMP	140043	WIS	4232	8808
254	CHAIN-O-LAKES	140053	WIS	4420	8910
255	DEVILS	140073	WIS	4325	8944
256	GENEVA	140093	WIS	4234	8830
257	ISLAND	140103	WIS	4608	8947
258	KEGONSA	140123	WIS	4258	8915
259	MENDOTA	140153	WIS	4307	8925
260	MONONA	140183	WIS	4304	8922
261	NAGAWICKA	140193	WIS	4305	8823
262	ROCK	140213	WIS	4305	8854
263	SHELL	140233	WIS	4544	9154
264	SPOONER	140243	WIS	4550	9149
265	SUMMIT	140253	WIS	4628	9215
266	TROUT	140263	WIS	4603	8940
267	WAUBESA	140273	WIS	4301	8919
268	WINGRA	140305	WIS	4303	8925
269	WINNEBAGO	140313	WIS	4400	8824
270	BONE	140353	WIS	4532	9223
271	BROWNS	140373	WIS	4241	8815
272	MUD	140423	WIS	4242	8808
273	TURTLE	140453	WIS	4614	8915
274	PEWAUKEE	140473	WIS	4305	8817
275	PINE	140481	WIS	4307	8823
276	NORTH(EAST)	140491	WIS	4309	8823
277	NORTH(WEST)	140501	WIS	4309	8823
278	OKAUCHEE	140511	WIS	4308	8826
279	OCONOMOWOC(MAIN)	140521	WIS	4306	8828
280	FOWLER	140531	WIS	4307	8830
281	LAC LA BELLE	140541	WIS	4308	8831
282	SILVER	140551	WIS	4305	8830
283	DELAVAN	140561	WIS	4237	8836
284	GREEN	140571	WIS	4349	8900
285	BEULAH(4BASINS)	140581	WIS	4249	8823
286	BIG CEDAR	140591	WIS	4323	8816
287	BUTTERNUT	140611	WIS	4558	9031

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	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
288	BEAR	140621	WIS	4538	9149
289	PRAIRIE	140631	WIS	4522	9141
290	RED CEDAR	140641	WIS	4536	9135
291	LOWER EAU CLAIRE	140651	WIS	4616	9133
292	MIDDLE EAU CLAIR	140661	WIS	4618	9131
293	NAMEKAGON	140671	WIS	4612	9107
294	UPPER EAU CLAIRE	140691	WIS	4619	9129
295	BIG SAND	140711	WIS	4550	9213
296	CLAM	140721	WIS	4548	9220
297	YELLOW	140731	WIS	4555	9224
298	LONG	140751	WIS	4515	9124
299	WISSOTA	140761	WIS	4457	9120
300	ARBUTUS	140771	WIS	4426	9042
301	FOX	140801	WIS	4335	8856
302	BARDON	140821	WIS	4613	9153
303	NEBAGAMON	140841	WIS	4630	9143
304	ST CROIX FLOWAGE	140851	WIS	4615	9152
305	ALTOONA	140881	WIS	4449	9126
306	EAU CLAIRE	140891	WIS	4446	9106
307	BUTTERNUT	140901	WIS	4555	8900
308	FRANKLIN	140911	WIS	4556	8900
309	KENTUCK	140921	WIS	4559	8900
310	PINE	140941	WIS	4541	8859
311	KOSHKONONG	140951	WIS	4252	8858
312	CALDRON FALLS RE	140961	WIS	4521	8815
313	HIGH FALLS RESER	140971	WIS	4519	8811
314	CLEAR	140991	WIS	4552	8938
315	PELICAN	141001	WIS	4530	8912
316	SQUIRREL	141021	WIS	4552	8954
317	TOMAHAWK	141031	WIS	4550	8940
318	THUNDER	141041	WIS	4547	8913
319	BALSAM	141051	WIS	4528	9226
320	BIG ROUND	141061	WIS	4532	9219
321	CEDAR	141071	WIS	4513	9235
322	WAPOGASSET	141081	WIS	4520	9226
323	PIKE	141091	WIS	4554	9004
324	ISLAND	141121	WIS	4519	9123
325	REDSTONE	141131	WIS	4337	9006
326	GRINDSTONE	141141	WIS	4556	9125
327	LAC COURT OREILL	141151	WIS	4554	9126
328	CHETEC	141161	WIS	4542	9130
329	CHIPPEWA	141171	WIS	4556	9110
330	LOST LAND	141181	WIS	4606	9109
331	MOOSE	141191	WIS	4601	9102
332	NELSON	141201	WIS	4605	9123
333	ROUND	141211	WIS	4601	9119
334	SPIDER	141221	WIS	4606	9114
335	TEAL	141231	WIS	4605	9107
336	SHAWANO	141241	WIS	4448	8832
337	BIG ST GERMAIN	141251	WIS	4556	8931
338	BIG MUSKELLUNGE	141261	WIS	4601	8937
339	BIG SAND	141271	WIS	4604	8859
340	CRAWLING STONE	141291	WIS	4656	8953
341	FENCE	141301	WIS	4557	8951
342	IKE WALTON	141321	WIS	4602	8948
343	LAC VIEUX DESERT	141331	WIS	4608	8907
344	PRESQUE ISLE	141351	WIS	4613	8947
345	COMO	141371	WIS	4236	8830

	LAKE NAME	ID CODE	S/P	LATITUDE DEG MIN	LONGITUDE DEG MIN
346	NANCY	141401	WIS	4606	9200
347	PARTRIDGE	141421	WIS	4417	8853
348	WHITE	141431	WIS	4422	8856
349	SINNISSIPPI	141441	WIS	4322	8837
350	PUCKAWAY	141451	WIS	4345	8912
351	POYGAN	141461	WIS	4409	8850
352	RUSH	141471	WIS	4356	8848
353	POTATO	141481	WIS	4519	9126
354	METONGA	141491	WIS	4532	8855
355	WILLOW RESERVOIR	141501	WIS	4543	8954
356	NORTH TWIN	141511	WIS	4603	8908
357	NOQUEBAY	141520	WIS	4516	8755

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APPENDIX B
SURVEY LAKE FREEZE/THAW HISTORY

STATISTICAL ANALYSIS FOR ALL LAKES WITH 0 OR MORE FREEZE/THAW OBSERVATIONS

1. NAME OF LAKE: BAKER ID CODE: 010034
STATE/PROV: NWT
LAT: 64 12 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 95 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 16 1956	-8	AUG 2 1957	7
	OCT 29 1957	5	JUL 29 1958	3
	OCT 28 1958	4	JUL 31 1959	5
	OCT 13 1959	-11	JUL 12 1960	-14
	OCT 21 1960	-3	JUL 17 1961	-9
	OCT 7 1961	-17	JUL 30 1962	4
	OCT 24 1962	0	JUL 31 1963	5
	OCT 21 1963	-3	JUL 21 1964	-5
	OCT 22 1964	-2	JUL 27 1965	1
	OCT 15 1965	-9	JUL 23 1966	-3
	OCT 27 1966	3	AUG 1 1967	6
	OCT 27 1967	3	JUL 28 1968	2
	NOV 4 1968	11	AUG 14 1969	19
	OCT 30 1969	6	JUL 13 1970	-13
	NOV 6 1970	13	JUL 18 1971	-8
	NOV 8 1971	15	***********	
	OCT 22 1972	-2	***********	
TOTAL	17		15	
EARLY	OCT 7		JUL 12	
LATE	NOV 8		AUG 14	
MEAN	OCT 24	8.37	JUL 26	8.45

2. NAME OF LAKE: UN-NAMED ID CODE: 010050
STATE/PROV: NWT
LAT: 68 45 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 100 4 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 18 1963	9
	***********		JUL 1 1966	-8
	OCT 1 1966	-6	***********	
	SEP 21 1967	-16	JUL 8 1968	-1
	SEP 30 1968	-7	JUL 15 1969	6
	OCT 10 1969	3	JUL 6 1970	-3
	SEP 27 1970	-10	JUL 7 1971	-2
	NOV 9 1971	33	***********	
TOTAL	6		6	
EARLY	SEP 21		JUL 1	
LATE	NOV 9		JUL 18	
MEAN	OCT 7	16.02	JUL 9	5.70

3. NAME OF LAKE: DOG POND ID CODE: 010065
STATE/PROV: NWT
LAT: 63 20 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 90 43 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 26 1963	23
	OCT 5 1963	1	JUL 10 1964	7
	OCT 5 1964	1	JUN 30 1965	-3
	SEP 27 1965	-7	JUN 12 1966	-21

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 9 1966	5	JUN 30 1967	-3
	SEP 21 1967	-13	JUL 1 1968	-2
	OCT 19 1968	15	***********	
TOTAL	6		5	
EARLY	SEP 21		JUN 12	
LATE	OCT 19		JUL 26	
MEAN	OCT 4	8.85	JUL 3	13.17

4. NAME OF LAKE: MISSION — ID CODE: 010074

STATE/PROV: NWT

LAT: 63 20 N — AREA: 0.0 (SQ KM) — MAX DEPTH: 0.0

LONG: 90 43 W — MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 5 1963	-5	JUL 10 1964	0
	OCT 5 1964	-5	JUL 11 1965	1
	SEP 27 1965	-13	JUL 3 1966	-7
	OCT 11 1966	1	JUL 12 1967	2
	OCT 5 1967	-5	JUL 12 1968	2
	OCT 22 1968	12	JUL 17 1969	7
	OCT 18 1969	8	JUL 3 1970	-7
	OCT 4 1970	-6	JUL 9 1971	-1
	NOV 9 1971	30	***********	
	SEP 24 1972	-16	***********	
TOTAL	10		8	
EARLY	SEP 24		JUL 3	
LATE	NOV 9		JUL 17	
MEAN	OCT 10	12.83	JUL 10	4.43

5. NAME OF LAKE: POLICE — ID CODE: 010085

STATE/PROV: NWT

LAT: 63 20 N — AREA: 0.0 (SQ KM) — MAX DEPTH: 0.0

LONG: 90 43 W — MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 10 1964	3
	OCT 5 1964	1	JUL 5 1965	-2
	SEP 27 1965	-7	JUN 30 1966	-7
	OCT 11 1966	7	JUL 10 1967	3
	OCT 3 1967	-1	JUL 11 1968	4
TOTAL	4		5	
EARLY	SEP 27		JUN 30	
LATE	OCT 11		JUL 11	
MEAN	OCT 4	5.00	JUL 7	4.17

6. NAME OF LAKE: UN-NAMED — ID CODE: 010095

STATE/PROV: NWT

LAT: 69 12 N — AREA: 0.0 (SQ KM) — MAX DEPTH: 0.0

LONG: 118 38 W — MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 5 1963	0
TOTAL	0		1	
EARLY	******		JUL 5	
LATE	******		JUL 5	
MEAN	******	0.0	JUL 5	0.0

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7. NAME OF LAKE: UN-NAMED (2) ID CODE: 010104
STATE/PROV: NWT
LAT: 69 35 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 120 45 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 11

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 15 1962	10	JUN 15 1963	-15
	SEP 30 1963	-5	***********	
	SEP 15 1964	-20	***********	
	OCT 1 1965	-4	JUN 28 1966	-2
	OCT 7 1966	2	***********	
	OCT 1 1967	-4	JUN 30 1968	0
	OCT 6 1968	1	JUL 10 1969	10
	OCT 18 1969	13	JUL 4 1970	4
	SEP 30 1970	-5	JUL 1 1971	1
	OCT 7 1971	2	***********	
	OCT 12 1972	7	***********	
TOTAL	11		6	
EARLY	SEP 15		JUN 15	
LATE	OCT 18		JUL 10	
MEAN	OCT 5	8.56	JUN 30	7.59

8. NAME OF LAKE: CONTWOYTO ID CODE: 010114
STATE/PROV: NWT
LAT: 65 29 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 110 22 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 6

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 15 1968	-4
	***********		JUL 30 1969	11
	***********		JUL 17 1970	-2
	OCT 14 1970	0	JUL 13 1971	-6
	OCT 22 1971	8	***********	
	OCT 7 1972	-7	***********	
TOTAL	3		4	
EARLY	OCT 7		JUL 13	
LATE	OCT 22		JUL 30	
MEAN	OCT 14	6.14	JUL 19	6.65

9. NAME OF LAKE: ENNADAI ID CODE: 010124
STATE/PROV: NWT
LAT: 61 8 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 100 55 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 18

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		JUN 24 1955	-12
OCT 26 1955	5	JUL 8 1956	2
OCT 18 1956	-3	JUL 17 1957	11
OCT 23 1957	2	JUL 19 1958	13
OCT 31 1958	10	JUL 8 1959	2
OCT 8 1959	-13	JUL 5 1960	-1
OCT 19 1960	-2	JUL 1 1961	-5
OCT 8 1961	-13	JUL 8 1962	2
OCT 29 1962	8	JUL 3 1963	-3
NOV 1 1963	11	JUL 9 1964	3
OCT 27 1964	6	JUN 28 1965	-8
OCT 22 1965	1	JUN 28 1965	-8

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 20 1966	-1	JUL 17 1967	11
	OCT 24 1967	3	JUL 9 1968	3
	NOV 3 1968	13	JUL 21 1969	15
	OCT 18 1969	-3	JUN 25 1970	-11
	OCT 10 1970	-11	JUN 22 1971	-14
	OCT 14 1972	-7	***********	
TOTAL	17		17	
EARLY	OCT 8		JUN 22	
LATE	NOV 3		JUL 21	
MEAN	OCT 21	7.90	JUL 6	8.71

10. NAME OF LAKE: GREATSLAVE/MCLOU ID CODE: 010134
STATE/PROV: NWT
LAT: 62 43 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 109 6 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 18

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUL 6 1953	4
	OCT 27 1953	-21	JUN 30 1954	-2
	NOV 7 1954	-10	JUN 21 1955	-11
	NOV 12 1955	-5	JUL 18 1956	16
	***********		JUN 24 1958	-8
	***********		JUL 14 1959	12
	***********		JUN 28 1960	-4
	***********		JUL 4 1962	2
	NOV 15 1962	-2	JUN 24 1963	-8
	NOV 18 1964	1	***********	
	NOV 11 1965	-6	JUN 24 1966	-8
	NOV 11 1965	-6	JUL 21 1967	19
	***********		JUL 6 1968	4
	***********		JUL 10 1969	8
	NOV 22 1969	5	JUN 21 1970	-11
	DEC 15 1970	28	JUN 23 1971	-9
	DEC 5 1971	18	***********	
	NOV 16 1972	-1	***********	
TOTAL	11		15	
EARLY	OCT 27		JUN 21	
LATE	DEC 15		JUL 21	
MEAN	NOV 17	12.71	JUL 2	9.65

11. NAME OF LAKE: GREATSLAVE/CHARL ID CODE: 010144
STATE/PROV: NWT
LAT: 62 43 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 109 6 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 11

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 13 1956	0	JUN 30 1957	4
	NOV 25 1957	12	***********	
	NOV 6 1959	-7	JUN 28 1960	2
	NOV 2 1960	-11	***********	
	NOV 5 1961	-8	***********	
	NOV 15 1962	2	JUN 21 1963	-5
	NOV 28 1968	15	JUL 7 1969	11
	NOV 15 1969	2	JUN 17 1970	-9
	NOV 10 1971	-3	JUN 17 1971	-9
	NOV 15 1971	2	JUL 2 1972	6
	NOV 5 1972	-8	***********	
TOTAL	11		7	
EARLY	NOV 2		JUN 17	
LATE	NOV 28		JUL 7	
MEAN	NOV 13	7.91	JUN 26	7.21

12. NAME OF LAKE: GREATSLAVE/RESO ID CODE: 010154
STATE/PROV: NWT
LAT: 61 11 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 113 41 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 26 1956	10	JUN 24 1957	14
	NOV 24 1957	8	MAY 29 1958	-12
	NOV 28 1958	12	JUN 13 1959	3
	***********		JUN 11 1960	1
	NOV 12 1960	-4	JUN 15 1961	5
	OCT 20 1961	-27	JUN 26 1962	16
	DEC 7 1962	21	JUN 6 1963	-4
	NOV 13 1963	-3	JUN 23 1964	13
	NOV 20 1964	4	JUN 16 1965	6
	NOV 25 1965	9	JUN 3 1966	-7
	NOV 26 1966	10	***********	
	NOV 12 1967	-4	***********	
	NOV 7 1968	-9	JUN 10 1969	0
	NOV 9 1969	-7	JUN 10 1970	0
	NOV 8 1970	-8	MAY 24 1971	-17
	NOV 8 1971	-3	JUN 2 1972	-8
	NOV 5 1972	-11	MAY 26 1973	-15
TOTAL	16		15	
EARLY	OCT 20		MAY 24	
LATE	DEC 7		JUN 26	
MEAN	NOV 15	11.44	JUN 10	9.93

13. NAME OF LAKE: UN-NAMED ID CODE: 010164
STATE/PROV: NWT
LAT: 68 40 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 97 48 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 11

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	SEP 20 1962	-7	JUL 17 1963	2
	SEP 15 1963	-12	JUL 28 1964	13
	SEP 21 1964	-6	***********	
	SEP 21 1965	-6	JUL 11 1966	-4
	OCT 8 1966	11	JUL 10 1967	-5
	OCT 1 1967	4	JUL 17 1968	2
	OCT 5 1968	8	JUL 20 1969	5
	SEP 21 1969	-6	JUL 20 1970	5
	SEP 30 1970	3	JUN 27 1971	-18
	OCT 17 1971	20	***********	
	SEP 21 1972	-6	***********	
TOTAL	11		8	
EARLY	SEP 15		JUN 27	
LATE	OCT 17		JUL 28	
MEAN	SEP 27	9.28	JUL 15	8.60

14. NAME OF LAKE: GREAT SLAVE ID CODE: 010174
STATE/PROV: NWT
LAT: 60 51 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 115 46 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 6

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
DEC 15 1956	2	JUL 1 1957	-2

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 14 1957	1	************	
	DEC 18 1958	5	JUL 4 1959	1
	DEC 9 1959	-4	************	
	DEC 7 1960	-6	************	
	DEC 15 1961	2	************	
TOTAL	6		2	
EARLY	DEC 7		JUL 1	
LATE	DEC 18		JUL 4	
MEAN	DEC 13	3.79	JUL 3	1.58

15. NAME OF LAKE: UN-NAMED ID CODE: 010194
STATE/PROV: NWT
LAT: 68 39 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 101 44 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	SEP 14 1964	-12	JUL 20 1965	8
	************		JUL 6 1966	-6
	SEP 26 1966	2	************	
	SEP 17 1967	-9	JUL 15 1968	3
	OCT 1 1968	5	JUL 19 1969	7
	OCT 11 1969	15	JUL 5 1970	-7
	SEP 26 1970	0	JUL 8 1971	-4
	OCT 4 1971	8	************	
	SEP 16 1972	-10	************	
TOTAL	8		6	
EARLY	SEP 14		JUL 5	
LATE	OCT 11		JUL 20	
MEAN	SEP 25	8.97	JUL 12	6.10

16. NAME OF LAKE: MODULE ID CODE: 010216
STATE/PROV: NWT
LAT: 68 30 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 113 13 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 11

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		JUN 22 1963	-8
	OCT 15 1963	9	************	
	************		JUL 7 1965	7
	SEP 20 1965	-16	JUN 19 1966	-11
	OCT 16 1966	10	JUL 13 1967	13
	SEP 23 1967	-13	JUN 28 1968	-2
	OCT 14 1968	8	JUL 11 1969	11
	OCT 21 1969	15	************	
	************		JUN 21 1971	-9
	OCT 10 1971	4	************	
	SEP 18 1972	-18	************	
TOTAL	8		7	
EARLY	SEP 18		JUN 19	
LATE	OCT 21		JUL 13	
MEAN	OCT 6	12.42	JUN 30	9.33

17. NAME OF LAKE: BAGNELL ID CODE: 010224
STATE/PROV: NWT
LAT: 68 18 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 85 41 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 31 1963	15	***********	
	OCT 12 1965	-3	***********	
	OCT 21 1966	6	AUG 7 1967	9
	SEP 29 1967	-16	AUG 10 1968	12
	OCT 25 1968	10	JUL 15 1969	-14
	OCT 22 1969	7	JUL 28 1970	-1
	OCT 16 1970	1	JUL 25 1971	-4
	SEP 16 1971	-29	***********	
	OCT 20 1972	5	***********	
TOTAL	9		5	
EARLY	SEP 16		JUL 15	
LATE	OCT 31		AUG 10	
MEAN	OCT 15	13.22	JUL 29	9.36

18. NAME OF LAKE: LAKE BARROW ID CODE: 010254
STATE/PROV: NWT
LAT: 68 26 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 89 39 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 20 1962	7	AUG 25 1963	9
	SEP 30 1963	-13	AUG 12 1964	-4
	OCT 27 1966	14	***********	
	OCT 8 1967	-5	AUG 18 1968	2
	OCT 24 1968	11	***********	
	OCT 20 1969	7	***********	
	OCT 10 1970	-3	AUG 9 1971	-7
	OCT 13 1971	0	***********	
	SEP 27 1972	-16	***********	
TOTAL	9		4	
EARLY	SEP 27		AUG 9	
LATE	OCT 27		AUG 25	
MEAN	OCT 13	9.85	AUG 16	6.12

19. NAME OF LAKE: GREAT BEAR ID CODE: 010264
STATE/PROV: NWT
LAT: 66 5 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 118 2 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 14

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		JUL 5 1952	-5
NOV 17 1952	-6	JUL 4 1953	-6
NOV 15 1953	-8	JUL 8 1954	-2
NOV 20 1954	-3	JUL 5 1955	-5
NOV 16 1955	-7	JUL 12 1956	2
NOV 13 1956	-10	JUL 26 1957	16
NOV 25 1957	2	JUL 11 1958	1
NOV 28 1958	5	JUL 23 1959	13
NOV 11 1959	-12	***********	
NOV 12 1960	-11	***********	
NOV 25 1969	2	JUL 8 1970	-2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 7 1970	14	JUN 27 1971	-13
	DEC 17 1971	24	************	
	DEC 5 1972	12	************	
TOTAL	13		10	
EARLY	NOV 11		JUN 27	
LATE	DEC 17		JUL 26	
MEAN	NOV 23	10.64	JUL 10	8.32

20. NAME OF LAKE: UN-NAMED   ID CODE: 010275
STATE/PROV: NWT
LAT: 68 35 N   AREA: 0.0 (SQ KM)   MAX DEPTH: 0.0
LONG: 111 6 W   MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

21. NAME OF LAKE: UN-NAMED   ID CODE: 010304
STATE/PROV: NWT
LAT: 68 49 N   AREA: 0.0 (SQ KM)   MAX DEPTH: 0.0
LONG: 93 25 W   MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	SEP 15 1962	-14	JUL 23 1963	13
	OCT 1 1964	2	JUN 29 1965	-11
	SEP 11 1965	-18	JUL 3 1966	-7
	OCT 8 1966	9	************	
	SEP 10 1967	-19	JUN 28 1968	-12
	OCT 7 1968	8	************	
	OCT 21 1969	22	JUL 18 1970	6
	SEP 28 1970	-1	JUL 21 1971	11
	OCT 22 1971	23	************	
	SEP 15 1972	-14	************	
TOTAL	10		5	
EARLY	SEP 10		JUN 28	
LATE	OCT 22		JUL 23	
MEAN	SEP 29	14.97	JUL 10	10.55

22. NAME OF LAKE: FRAME   ID CODE: 010324
STATE/PROV: NWT
LAT: 62 28 N   AREA: 0.0 (SQ KM)   MAX DEPTH: 0.0
LONG: 114 27 W   MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 19

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		MAY 22 1955	-6
************		MAY 28 1956	0
OCT 13 1956	-6	JUN 1 1957	4
OCT 17 1957	-2	MAY 23 1958	-5
OCT 10 1958	-9	JUN 8 1959	11
NOV 7 1959	19	MAY 27 1960	-1
OCT 18 1960	-1	MAY 29 1961	1
OCT 8 1961	-11	JUN 3 1962	6
OCT 18 1962	-1	MAY 17 1963	-11
OCT 30 1963	11	MAY 30 1964	2
OCT 19 1964	0	MAY 27 1965	-1
OCT 18 1965	-1	MAY 25 1966	-3
OCT 18 1966	-1	JUN 2 1967	5
OCT 20 1967	1	JUN 3 1968	6

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 29 1968	10	MAY 26 1969	-2
	OCT 12 1969	-7	MAY 29 1970	1
	OCT 16 1970	-3	MAY 20 1971	-8
	OCT 25 1971	6	MAY 30 1972	2
	OCT 10 1972	-9	***********	
TOTAL	17		18	
EARLY	OCT 8		MAY 17	
LATE	NOV 7		JUN 8	
MEAN	OCT 19	7.68	MAY 28	5.30

23. NAME OF LAKE: LONG ID CODE: 010334
STATE/PROV: NWT
LAT: 62 28 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 114 27 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 19

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 23 1955	-6
	OCT 28 1955	3	JUN 2 1956	4
	OCT 14 1956	-11	JUN 4 1957	6
	OCT 21 1957	-4	MAY 25 1958	-4
	OCT 31 1958	5	JUN 10 1959	12
	OCT 11 1959	-14	MAY 29 1960	0
	OCT 21 1960	-4	MAY 31 1961	2
	OCT 20 1961	-5	JUN 6 1962	8
	NOV 1 1962	7	MAY 21 1963	-8
	OCT 31 1963	6	JUN 2 1964	4
	OCT 26 1964	1	MAY 30 1965	1
	OCT 29 1965	4	MAY 27 1966	-2
	OCT 20 1966	-5	JUN 1 1967	3
	NOV 1 1967	7	JUN 5 1968	7
	OCT 29 1968	4	JUN 1 1969	3
	NOV 10 1969	16	MAY 30 1970	1
	NOV 3 1970	9	MAY 18 1971	-11
	OCT 27 1971	2	MAY 29 1972	0
	OCT 10 1972	-15	MAY 17 1973	-12
TOTAL	18		19	
EARLY	OCT 10		MAY 17	
LATE	NOV 10		JUN 10	
MEAN	OCT 25	8.09	MAY 29	6.22

24. NAME OF LAKE: COLD ID CODE: 020014
STATE/PROV: ALB
LAT: 54 25 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 110 17 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 33

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		MAY 6 1941	-11
***********		MAY 17 1942	0
***********		MAY 22 1943	5
***********		MAY 4 1944	-13
***********		MAY 23 1945	6
***********		MAY 8 1946	-9
***********		MAY 21 1947	4
***********		MAY 20 1948	3
***********		MAY 11 1949	-6
***********		MAY 25 1950	8
***********		MAY 16 1951	-1
***********		MAY 10 1952	-7
DEC 26 1952	8	MAY 26 1953	9
DEC 25 1953	7	MAY 24 1954	7
NOV 27 1954	-21	MAY 23 1955	6

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		MAY 21 1956	4
DEC 14 1956	-4	MAY 22 1957	5
DEC 29 1957	11	MAY 6 1958	-11
***********		MAY 18 1959	1
DEC 22 1959	4	MAY 12 1960	-5
DEC 27 1960	9	MAY 12 1961	-5
DEC 18 1961	0	MAY 24 1962	7
DEC 29 1962	11	MAY 16 1963	-1
DEC 18 1963	0	MAY 9 1964	-8
DEC 13 1964	-5	MAY 16 1965	-1
DEC 26 1965	8	MAY 15 1966	-2
DEC 3 1966	-15	MAY 26 1967	9
DEC 21 1967	3	MAY 19 1968	2
DEC 25 1968	7	MAY 13 1969	-4
DEC 20 1969	2	MAY 15 1970	-2
DEC 7 1970	-11	MAY 10 1971	-7
DEC 12 1971	-6	MAY 21 1972	4
DEC 11 1972	-7	MAY 19 1973	2
TOTAL 19		33	
EARLY NOV 27		MAY 4	
LATE DEC 29		MAY 26	
MEAN DEC 18	8.86	MAY 17	6.23

25. NAME OF LAKE: ATHABASCA — ID CODE: 020044
STATE/PROV: ALB
LAT: 58 43 N — AREA: 7900.00 — MAX DEPTH: 120.0
LONG: 111 9 W — (SQ KM) — MEAN DEPTH: 26.0
(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 10

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		MAY 20 1963	-7
***********		MAY 17 1965	-10
NOV 29 1965	-1	MAY 13 1965	-14
NOV 9 1966	-21	MAY 21 1967	-6
NOV 26 1967	-4	MAY 20 1968	-7
NOV 27 1968	-3	MAY 19 1969	-8
DEC 19 1969	19	JUN 9 1970	13
NOV 20 1970	-10	JUN 7 1971	11
DEC 6 1971	6	JUN 15 1972	19
DEC 10 1972	10	JUN 1 1973	5
TOTAL 8		10	
EARLY NOV 9		MAY 13	
LATE DEC 19		JUN 15	
MEAN NOV 30	11.53	MAY 27	10.82

26. NAME OF LAKE: BEAR — ID CODE: 020054
STATE/PROV: ALB
LAT: 55 11 N — AREA: 0.0 — MAX DEPTH: 0.0
LONG: 118 53 W — (SQ KM) — MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 17

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
NOV 1 1956	-6	MAY 4 1957	0
NOV 17 1957	10	APR 30 1958	-4
NOV 12 1958	5	APR 28 1959	-6
NOV 4 1959	-3	APR 25 1960	-9
NOV 9 1960	2	MAY 2 1961	-2
NOV 1 1961	-6	MAY 1 1962	-3
NOV 16 1962	9	MAY 6 1963	2
NOV 8 1963	1	MAY 9 1964	5
NOV 13 1964	6	***********	
***********		MAY 8 1966	4
NOV 6 1966	-1	MAY 9 1967	5

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 12 1967	5	MAY 5 1968	1
	NOV 14 1968	7	MAY 4 1969	0
	OCT 23 1969	-15	APR 29 1970	-5
	NOV 4 1970	-3	MAY 3 1971	-1
	OCT 24 1971	-14	MAY 10 1972	6
	NOV 6 1972	-1	***********	
TOTAL	16		15	
EARLY	OCT 23		APR 25	
LATE	NOV 17		MAY 10	
MEAN	NOV 7	7.22	MAY 4	4.31

27. NAME OF LAKE: LAC LA BICHE ID CODE: 020064
STATE/PROV: ALB
LAT: 54 46 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 111 58 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 28

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 6 1944	-11	***********	
	***********		APR 30 1946	-13
	NOV 13 1946	-4	MAY 17 1947	4
	NOV 23 1947	5	MAY 18 1948	5
	NOV 30 1948	13	MAY 12 1949	-1
	NOV 9 1949	-8	MAY 17 1950	4
	OCT 28 1950	-20	MAY 13 1951	0
	NOV 23 1951	6	MAY 14 1952	1
	NOV 22 1952	5	MAY 9 1953	-4
	NOV 29 1953	12	MAY 25 1954	12
	NOV 11 1954	-6	MAY 16 1955	3
	***********		MAY 20 1956	7
	NOV 12 1956	-5	MAY 15 1957	2
	NOV 20 1957	3	MAY 5 1958	-8
	NOV 23 1958	5	MAY 8 1959	-5
	NOV 11 1959	-6	MAY 12 1960	-1
	NOV 12 1960	-5	MAY 12 1961	-1
	NOV 27 1962	10	MAY 15 1963	2
	NOV 18 1963	1	MAY 10 1964	-3
	NOV 19 1964	2	MAY 14 1965	1
	NOV 14 1965	-3	MAY 11 1966	-2
	NOV 6 1966	-11	MAY 20 1967	7
	NOV 20 1967	3	MAY 4 1968	-9
	NOV 16 1968	-1	MAY 5 1969	-8
	NOV 13 1969	-4	MAY 11 1970	-2
	NOV 20 1970	3	MAY 7 1971	-6
	***********		MAY 21 1972	8
	NOV 22 1972	5	MAY 31 1973	18
TOTAL	25		27	
EARLY	OCT 28		APR 30	
LATE	NOV 30		MAY 31	
MEAN	NOV 17	7.68	MAY 13	6.61

28. NAME OF LAKE: LESSER SLAVE ID CODE: 020074
STATE/PROV: ALB
LAT: 55 21 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 114 59 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 21

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
***********		MAY 18 1953	-2
DEC 4 1953	7	MAY 25 1954	5
NOV 13 1954	-14	MAY 20 1955	0
DEC 13 1955	16	MAY 21 1956	1
DEC 3 1956	6	MAY 23 1957	3

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 4 1957	7	************	
	************		MAY 20 1959	0
	NOV 16 1959	-11	MAY 14 1960	-6
	NOV 29 1960	2	MAY 22 1961	2
	NOV 25 1961	-2	MAY 25 1962	5
	DEC 4 1962	7	MAY 16 1963	-4
	NOV 22 1963	-5	MAY 17 1964	-3
	NOV 29 1964	2	MAY 29 1965	9
	NOV 29 1965	2	MAY 23 1966	3
	NOV 15 1966	-12	MAY 27 1967	7
	NOV 30 1967	3	MAY 12 1968	-8
	DEC 3 1968	6	MAY 17 1969	-3
	NOV 19 1969	-8	MAY 15 1970	-5
	NOV 23 1970	-4	MAY 15 1971	-5
	NOV 27 1971	0	MAY 23 1972	3
	NOV 24 1972	-3	************	
TOTAL	19		19	
EARLY	NOV 13		MAY 12	
LATE	DEC 13		MAY 29	
MEAN	NOV 27	7.52	MAY 20	4.59

29. NAME OF LAKE: LAKE MINNEWANKA ID CODE: 020084
STATE/PROV: ALB
LAT: 51 11 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 115 34 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 32

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 14 1940	-3
	DEC 27 1940	3	MAY 5 1941	-12
	DEC 21 1941	-3	MAY 10 1942	-7
	JAN 1 1943	8	MAY 27 1943	10
	JAN 25 1944	32	MAY 5 1944	-12
	DEC 31 1944	7	MAY 30 1945	13
	DEC 17 1945	-7	APR 29 1946	-18
	DEC 12 1946	-12	MAY 10 1947	-7
	JAN 14 1948	21	MAY 17 1948	0
	DEC 13 1948	-11	MAY 8 1949	-9
	DEC 17 1949	-7	MAY 26 1950	9
	DEC 2 1950	-22	MAY 12 1951	-5
	DEC 14 1951	-10	MAY 8 1952	-9
	JAN 6 1953	13	MAY 16 1953	-1
	JAN 7 1954	14	MAY 26 1954	9
	DEC 29 1954	5	MAY 27 1955	10
	NOV 25 1955	-29	MAY 26 1956	9
	JAN 17 1957	24	MAY 21 1957	4
	DEC 7 1958	-17	MAY 16 1959	-1
	DEC 27 1959	3	MAY 7 1960	-10
	DEC 20 1960	-4	MAY 23 1961	6
	DEC 8 1961	-16	MAY 22 1962	5
	************		MAY 17 1963	0
	DEC 15 1963	-9	MAY 21 1964	4
	DEC 16 1964	-3	MAY 24 1965	7
	DEC 25 1965	1	MAY 7 1966	-10
	JAN 25 1967	32	MAY 17 1968	0
	DEC 15 1968	-9	MAY 11 1969	-6
	DEC 29 1969	5	JUN 7 1970	21
	DEC 23 1970	-1	MAY 14 1971	-3
	DEC 20 1971	-4	MAY 21 1972	4
	DEC 21 1972	-3	MAY 17 1973	0
TOTAL	30		32	
EARLY	NOV 25		APR 29	
LATE	JAN 25		JUN 7	
MEAN	DEC 24	14.34	MAY 17	8.60

30. NAME OF LAKE: GLENMORE RESERVO   ID CODE: 020094

STATE/PROV:	ALB		
LAT: 51 6 N	AREA: 0.0	MAX DEPTH:	0.0
LONG: 114 1 W	(SQ KM)	MEAN DEPTH:	0.0
			(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 12 1966	-2	MAY 20 1967	17
	NOV 24 1967	10	MAY 3 1968	0
	***********		APR 18 1969	-15
	***********		MAY 6 1970	3
	NOV 11 1970	-3	***********	
	NOV 8 1971	-6	APR 29 1972	-4
	NOV 15 1972	1	***********	
TOTAL	5		5	
EARLY	NOV 8		APR 18	
LATE	NOV 24		MAY 20	
MEAN	NOV 14	5.48	MAY 3	10.38

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31.  NAME OF LAKE: FROBISHER                ID CODE:  030011
     STATE/PROV:    SAS
     LAT:    56 19 N      AREA:  313.00     MAX DEPTH:    19.0
     LONG: 107 57 W             (SQ KM)     MEAN DEPTH:    5.5
                                                        (METERS)

     FREEZE/THAW HISTORY             NUMBER OF ENTRIES:     0
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32.  NAME OF LAKE: JAN                      ID CODE:  030041
     STATE/PROV:    SAS
     LAT:    54 55 N      AREA:  114.00     MAX DEPTH:    32.5
     LONG: 102 55 W             (SQ KM)     MEAN DEPTH:    7.8
                                                        (METERS)

     FREEZE/THAW HISTORY             NUMBER OF ENTRIES:     0
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33.  NAME OF LAKE: MIROND                   ID CODE:  030051
     STATE/PROV:    SAS
     LAT:    55  7 N      AREA:  108.00     MAX DEPTH:    45.5
     LONG: 102 47 W             (SQ KM)     MEAN DEPTH:   13.8
                                                        (METERS)

     FREEZE/THAW HISTORY             NUMBER OF ENTRIES:     0
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34.  NAME OF LAKE: PELICAN                  ID CODE:  030061
     STATE/PROV:    SAS
     LAT:    55  9 N      AREA:  100.30     MAX DEPTH:    32.0
     LONG: 103  0 W             (SQ KM)     MEAN DEPTH:   11.5
                                                        (METERS)

     FREEZE/THAW HISTORY             NUMBER OF ENTRIES:     0
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35.  NAME OF LAKE: MCINTOSH                 ID CODE:  030071
     STATE/PROV:    SAS
     LAT:    55 50 N      AREA:   60.70     MAX DEPTH:    45.5
     LONG: 105  0 W             (SQ KM)     MEAN DEPTH:   12.8
                                                        (METERS)

     FREEZE/THAW HISTORY             NUMBER OF ENTRIES:     0
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36. NAME OF LAKE: WILDNEST　　ID CODE: 030101
STATE/PROV: SAS
LAT: 55 0 N　　AREA: 46.40　　MAX DEPTH: 32.8
LONG: 102 20 W　　(SQ KM)　　MEAN DEPTH: 6.8
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

37. NAME OF LAKE: ANNABEL　　ID CODE: 030151
STATE/PROV: SAS
LAT: 54 50 N　　AREA: 12.20　　MAX DEPTH: 4.9
LONG: 102 13 W　　(SQ KM)　　MEAN DEPTH: 1.5
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

38. NAME OF LAKE: JOHNSON　　ID CODE: 030181
STATE/PROV: SAS
LAT: 54 51 N　　AREA: 7.14　　MAX DEPTH: 3.8
LONG: 102 17 W　　(SQ KM)　　MEAN DEPTH: 1.8
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

39. NAME OF LAKE: TYRELL　　ID CODE: 030191
STATE/PROV: SAS
LAT: 54 53 N　　AREA: 6.11　　MAX DEPTH: 7.0
LONG: 102 8 W　　(SQ KM)　　MEAN DEPTH: 3.0
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

40. NAME OF LAKE: CONTACT　　ID CODE: 030231
STATE/PROV: SAS
LAT: 56 13 N　　AREA: 4.18　　MAX DEPTH: 24.7
LONG: 103 43 W　　(SQ KM)　　MEAN DEPTH: 6.9
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

41. NAME OF LAKE: WOLLASTON　　ID CODE: 030351
STATE/PROV: SAS
LAT: 58 15 N　　AREA: 2062.00　　MAX DEPTH: 97.0
LONG: 103 20 W　　(SQ KM)　　MEAN DEPTH: 20.6
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

42. NAME OF LAKE: AMISK　　ID CODE: 030361
STATE/PROV: SAS
LAT: 54 33 N　　AREA: 321.00　　MAX DEPTH: 40.0
LONG: 102 15 W　　(SQ KM)　　MEAN DEPTH: 13.2
(METERS)

FREEZE/THAW HISTORY　　NUMBER OF ENTRIES: 0

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43. NAME OF LAKE: BIG PETER POND   ID CODE: 030371
STATE/PROV: SAS
LAT: 56 0 N   AREA: 552.00   MAX DEPTH: 24.0
LONG: 108 50 W   (SQ KM)   MEAN DEPTH: 13.7
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

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44. NAME OF LAKE: LITTLE PETER PON   ID CODE: 030381
STATE/PROV: SAS
LAT: 55 47 N   AREA: 189.00   MAX DEPTH: 9.5
LONG: 108 35 W   (SQ KM)   MEAN DEPTH: 5.1
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

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45. NAME OF LAKE: ILE A LA CROSSE   ID CODE: 030391
STATE/PROV: SAS
LAT: 55 27 N   AREA: 446.00   MAX DEPTH: 27.0
LONG: 107 50 W   (SQ KM)   MEAN DEPTH: 8.2
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

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46. NAME OF LAKE: EKAPO   ID CODE: 03041A
STATE/PROV: SAS
LAT: 50 23 N   AREA: 0.0   MAX DEPTH: 0.0
LONG: 102 35 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 7 1956	0	MAY 1 1957	7
	OCT 24 1957	-14	APR 14 1958	-10
	OCT 26 1958	-12	APR 25 1959	1
	NOV 11 1959	4	APR 23 1960	-1
	NOV 9 1960	2	APR 18 1961	-6
	NOV 2 1961	-5	APR 22 1962	-2
	NOV 13 1962	6	APR 16 1963	-8
	NOV 19 1963	12	************	
	NOV 15 1964	8	APR 30 1965	6
	NOV 20 1965	13	MAY 7 1966	13
	NOV 6 1966	-1	APR 26 1967	2
	NOV 3 1967	-4	APR 25 1968	1
	NOV 11 1968	4	APR 22 1969	-2
	OCT 27 1969	-11	MAY 12 1970	18
	NOV 19 1970	12	APR 28 1971	4
	NOV 4 1971	-3	APR 29 1972	5
	OCT 23 1972	-15	MAR 29 1973	-26
TOTAL	17		16	
EARLY	OCT 23		MAR 29	
LATE	NOV 20		MAY 12	
MEAN	NOV 7	8.85	APR 24	9.71

47. NAME OF LAKE: CHURCHILL ID CODE: 030422
STATE/PROV: SAS
LAT: 55 51 N AREA: 433.00 MAX DEPTH: 21.0
LONG: 108 27 W (SQ KM) MEAN DEPTH: 9.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 14 1969	12
	NOV 13 1969	-1	APR 9 1970	-23
	NOV 18 1970	4	MAY 14 1971	12
	NOV 11 1971	-3	***********	
	NOV 12 1972	-2	***********	
TOTAL	4		3	
EARLY	NOV 11		APR 9	
LATE	NOV 18		MAY 14	
MEAN	NOV 14	2.74	MAY 2	16.50

48. NAME OF LAKE: CREE ID CODE: 030432
STATE/PROV: SAS
LAT: 57 21 N AREA: 1155.00 MAX DEPTH: 60.0
LONG: 106 50 W (SQ KM) MEAN DEPTH: 14.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 4

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUN 8 1970	6
	NOV 25 1970	5	MAY 28 1971	-5
	NOV 30 1971	10	JUN 3 1972	1
	NOV 6 1972	-14	MAY 31 1973	-2
TOTAL	3		4	
EARLY	NOV 6		MAY 28	
LATE	NOV 30		JUN 8	
MEAN	NOV 20	10.34	JUN 2	4.06

49. NAME OF LAKE: LAC LA RONGE ID CODE: 030442
STATE/PROV: SAS
LAT: 55 8 N AREA: 1178.00 MAX DEPTH: 38.0
LONG: 105 20 W (SQ KM) MEAN DEPTH: 12.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		JUN 4 1967	12
	DEC 2 1967	2	MAY 25 1968	2
	DEC 5 1968	5	MAY 3 1969	-20
	DEC 15 1969	15	MAY 27 1970	4
	NOV 30 1970	0	MAY 22 1971	-1
	NOV 28 1971	-2	MAY 22 1972	-1
	NOV 7 1972	-23	MAY 28 1973	5
TOTAL	6		7	
EARLY	NOV 7		MAY 3	
LATE	DEC 15		JUN 4	
MEAN	NOV 30	11.45	MAY 23	9.19

50. NAME OF LAKE: MEADOW ID CODE: 030451
STATE/PROV: SAS
LAT: 54 7 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 108 26 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 29 1969	14
	OCT 20 1969	-1	APR 3 1970	-12
	OCT 29 1970	8	APR 13 1971	-2
	OCT 25 1971	4	************	
	OCT 8 1972	-13	************	
TOTAL	4		3	
EARLY	OCT 8		APR 3	
LATE	OCT 29		APR 29	
MEAN	OCT 21	7.91	APR 15	10.71

51. NAME OF LAKE: WASCANA ID CODE: 030464
STATE/PROV: SAS
LAT: 50 26 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 104 40 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 33

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 15 1940	1
	NOV 13 1940	-3	APR 5 1941	-9
	NOV 18 1941	2	************	
	NOV 6 1942	-10	APR 3 1943	-11
	NOV 5 1943	-11	************	
	NOV 13 1945	-3	************	
	NOV 15 1946	-1	************	
	NOV 8 1947	-8	APR 19 1948	5
	NOV 10 1948	-6	************	
	************		APR 19 1950	5
	************		APR 29 1951	15
	************		APR 15 1952	1
	NOV 7 1952	-9	APR 26 1953	12
	NOV 15 1953	-1	************	
	NOV 28 1954	12	************	
	NOV 2 1955	-14	APR 19 1956	5
	DEC 7 1956	21	APR 28 1957	14
	************		APR 6 1958	-8
	NOV 17 1958	1	APR 7 1959	-7
	NOV 13 1959	-3	APR 15 1960	1
	NOV 28 1960	12	APR 15 1961	1
	************		APR 14 1962	0
	DEC 11 1962	25	APR 5 1963	-9
	NOV 21 1963	5	APR 22 1964	8
	NOV 21 1964	5	APR 26 1965	12
	NOV 12 1965	-4	APR 6 1966	-8
	NOV 8 1966	-8	APR 20 1967	6
	NOV 14 1967	-2	APR 3 1968	-11
	DEC 10 1968	24	APR 10 1969	-4
	NOV 10 1969	-6	APR 18 1970	4
	NOV 6 1970	-10	APR 14 1971	0
	NOV 2 1971	-14	APR 14 1972	0
	NOV 12 1972	-4	MAR 15 1973	-30
TOTAL	27		26	
EARLY	NOV 2		MAR 15	
LATE	DEC 11		APR 29	
MEAN	NOV 16	10.62	APR 14	9.61

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52. NAME OF LAKE: BEAVERLODGE ID CODE: 030472
STATE/PROV: SAS
LAT: 59 34 N AREA: 47.70 MAX DEPTH: 70.0
LONG: 108 29 W (SQ KM) MEAN DEPTH: 30.5
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 23

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 29 1951	-5
	NOV 24 1951	-1	MAY 22 1952	-12
	DEC 4 1952	9	JUN 3 1953	0
	NOV 24 1953	-1	MAY 28 1954	-6
	DEC 2 1954	7	JUN 1 1955	-2
	NOV 21 1955	-4	JUN 6 1956	3
	NOV 21 1956	-4	JUN 7 1957	4
	NOV 25 1957	0	MAY 30 1958	-4
	NOV 28 1958	3	JUN 15 1959	12
	NOV 12 1959	-13	JUN 3 1960	0
	NOV 23 1960	-2	JUN 6 1961	3
	NOV 23 1961	-2	JUN 5 1962	2
	NOV 24 1962	-1	JUN 4 1963	1
	NOV 27 1963	2	JUN 3 1964	0
	NOV 25 1964	0	JUN 6 1965	3
	NOV 19 1965	-6	JUN 1 1966	-2
	NOV 14 1966	-11	JUN 13 1967	10
	DEC 3 1967	8	JUN 8 1968	5
	DEC 3 1968	8	JUN 6 1969	3
	NOV 21 1969	-4	MAY 30 1970	-4
	NOV 27 1970	2	MAY 26 1971	-8
	DEC 6 1971	11	JUN 8 1972	5
	NOV 19 1972	-6	MAY 29 1973	-5
TOTAL	22		23	
EARLY	NOV 12		MAY 22	
LATE	DEC 5		JUN 15	
MEAN	NOV 25	6.09	JUN 3	5.46

53. NAME OF LAKE: BIG QUILL ID CODE: 030484
STATE/PROV: SAS
LAT: 51 46 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 104 12 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 17 1956	1	MAY 9 1957	4
	NOV 28 1957	12	MAY 1 1958	-4
	NOV 20 1958	4	MAY 13 1959	8
	NOV 12 1959	-4	MAY 5 1960	0
	NOV 10 1960	-6	MAY 5 1961	0
	OCT 25 1961	-22	MAY 5 1962	0
	NOV 30 1962	14	APR 29 1963	-6
	NOV 22 1963	6	MAY 6 1964	1
	NOV 28 1964	12	MAY 8 1965	3
	NOV 10 1965	-5	MAY 10 1966	5
	NOV 5 1966	-11	MAY 16 1967	11
	NOV 25 1967	9	APR 29 1968	-6
	DEC 2 1968	16	APR 23 1969	-12
	NOV 10 1969	-6	MAY 5 1970	0
	NOV 26 1970	10	MAY 5 1971	0
	NOV 11 1971	-5	APR 30 1972	-5
	OCT 30 1972	-17	MAY 12 1973	7
TOTAL	17		17	
EARLY	OCT 25		APR 23	
LATE	DEC 2		MAY 16	
MEAN	NOV 16	10.89	MAY 5	5.65

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54. NAME OF LAKE: YORK — ID CODE: 030494
STATE/PROV: SAS
LAT: 51 16 N — AREA: 0.0 (SQ KM) — MAX DEPTH: 0.0
LONG: 102 28 W — MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 25 1956	8	MAY 10 1957	7
	NOV 8 1957	-9	APR 19 1958	-14
	NOV 25 1958	8	MAY 5 1959	2
	NOV 7 1959	-10	APR 25 1960	-8
	NOV 1 1960	-16	APR 28 1961	-5
	NOV 10 1961	-7	APR 29 1962	-4
	NOV 28 1962	11	APR 24 1963	-9
	NOV 24 1963	7	APR 30 1964	-3
	NOV 20 1964	3	MAY 4 1965	1
	NOV 13 1965	-4	MAY 17 1966	14
	NOV 15 1966	-2	MAY 23 1967	20
	DEC 10 1967	23	APR 25 1968	-8
	NOV 8 1968	-9	APR 29 1969	-4
	DEC 1 1969	14	MAY 14 1970	11
	NOV 16 1970	-1	APR 30 1971	-3
	NOV 8 1971	-9	MAY 2 1972	-1
	NOV 4 1972	-13	MAY 5 1973	2
TOTAL	17		17	
EARLY	NOV 1		APR 19	
LATE	DEC 10		MAY 23	
MEAN	NOV 17	10.49	MAY 3	8.60

55. NAME OF LAKE: REINDEER — ID CODE: 030501
STATE/PROV: SAS
LAT: 57 20 N — AREA: 5569.00 (SQ KM) — MAX DEPTH: 215.0
LONG: 102 20 W — MEAN DEPTH: 17.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

56. NAME OF LAKE: CANOE — ID CODE: 030555
STATE/PROV: SAS
LAT: 55 10 N — AREA: 0.0 (SQ KM) — MAX DEPTH: 0.0
LONG: 108 15 W — MEAN DEPTH: 0.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 4 1961	-4	MAY 29 1962	16
	************		MAY 13 1963	0
	************		MAY 10 1964	-3
	NOV 9 1964	1	MAY 13 1965	0
	************		MAY 10 1966	-3
	OCT 28 1966	-11	MAY 22 1967	9
	NOV 24 1967	16	MAY 7 1968	-6
	NOV 16 1968	8	MAY 1 1969	-12
	OCT 29 1969	-10	MAY 12 1970	-1
TOTAL	6		9	
EARLY	OCT 29		MAY 1	
LATE	NOV 24		MAY 29	
MEAN	NOV 8	9.64	MAY 13	7.72

57. NAME OF LAKE: PRIMROSE ID CODE: 030564
STATE/PROV: SAS
LAT: 54 55 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 109 43 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 13

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 3 1956	3	************	
	NOV 24 1961	-6	MAY 26 1962	9
	DEC 11 1962	11	************	
	DEC 18 1963	18	MAY 11 1964	-6
	NOV 29 1964	-1	MAY 16 1965	-1
	NOV 26 1965	-4	MAY 19 1966	2
	NOV 20 1966	-10	MAY 28 1967	11
	NOV 28 1967	-2	MAY 15 1968	-2
	************		MAY 9 1969	-8
	NOV 26 1969	-4	MAY 15 1970	-2
	************		MAY 9 1971	-8
	NOV 28 1971	-2	************	
	NOV 29 1972	-1	MAY 25 1973	8
TOTAL	11		10	
EARLY	NOV 20		MAY 9	
LATE	DEC 18		MAY 28	
MEAN	NOV 30	7.53	MAY 17	6.66

58. NAME OF LAKE: FARNSWORTH ID CODE: 040014
STATE/PROV: MAN
LAT: 58 45 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 94 4 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 16

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 19 1957	-1	JUL 2 1958	9
	NOV 6 1958	17	JUL 3 1959	10
	OCT 8 1959	-12	JUN 19 1960	-4
	OCT 20 1960	0	JUN 21 1961	-2
	OCT 20 1961	0	JUN 25 1962	2
	OCT 23 1962	3	JUN 22 1963	-1
	OCT 27 1963	7	JUN 29 1964	6
	SEP 29 1964	-21	JUN 18 1965	-5
	OCT 31 1965	11	JUN 22 1966	-1
	OCT 14 1966	-6	JUN 20 1967	-3
	OCT 18 1967	-2	JUN 16 1968	-7
	OCT 28 1968	8	JUN 30 1969	7
	NOV 1 1969	12	JUN 15 1970	-8
	OCT 9 1970	-11	JUN 14 1971	-9
	OCT 29 1971	9	************	
	OCT 9 1972	-11	************	
TOTAL	16		14	
EARLY	SEP 29		JUN 14	
LATE	NOV 6		JUL 3	
MEAN	OCT 20	10.08	JUN 23	6.09

59. NAME OF LAKE: ATHAPAPUSKOW ID CODE: 040023
STATE/PROV: MAN
LAT: 54 37 N AREA: 263.00 MAX DEPTH: 62.6
LONG: 101 21 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		JUN 2 1955	9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 28 1956	4
	************		MAY 19 1957	-5
	************		MAY 16 1958	-8
	************		MAY 26 1963	2
TOTAL	0		5	
EARLY	******		MAY 16	
LATE	******		JUN 2	
MEAN	******	0.0	MAY 24	6.16

60. NAME OF LAKE: LAKE DAUPHIN ID CODE: 040043
STATE/PROV: MAN
LAT: 51 6 N AREA: 518.40 MAX DEPTH: 4.5
LONG: 100 3 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 5 1948	-8	***********	
	NOV 9 1950	-4	APR 30 1951	5
	NOV 1 1951	-12	APR 26 1952	1
	NOV 23 1952	10	APR 29 1953	4
	NOV 22 1953	9	MAY 13 1954	18
	NOV 27 1954	14	APR 28 1955	3
	NOV 6 1955	-7	***********	
	NOV 10 1972	-3	MAR 23 1973	-33
TOTAL	8		6	
EARLY	NOV 1		MAR 23	
LATE	NOV 27		MAY 13	
MEAN	NOV 13	9.08	APR 25	15.62

61. NAME OF LAKE: SCHIST ID CODE: 040052
STATE/PROV: MAN
LAT: 54 41 N AREA: 18.10 MAX DEPTH: 0.0
LONG: 101 41 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 7 1956	-4	MAY 14 1957	0
	NOV 9 1957	-2	MAY 10 1958	-4
	NOV 16 1958	5	MAY 22 1959	8
	NOV 2 1959	-9	MAY 17 1960	3
	NOV 9 1960	-2	MAY 23 1961	9
	NOV 13 1961	2	***********	
	***********		MAY 14 1963	0
	***********		MAY 6 1964	-8
	NOV 22 1964	11	MAY 12 1965	-2
	***********		MAY 21 1966	7
	***********		MAY 26 1967	12
	***********		MAY 13 1968	-1
	NOV 12 1968	1	APR 29 1969	-15
	NOV 13 1969	2	MAY 17 1970	3
	NOV 19 1970	8	MAY 7 1971	-7
	NOV 7 1971	-4	***********	
	OCT 30 1972	-12	***********	
TOTAL	12		14	
EARLY	OCT 30		APR 29	
LATE	NOV 22		MAY 26	
MEAN	NOV 11	6.35	MAY 14	7.15

62. NAME OF LAKE: LAKE WINNIPEG ID CODE: 040082
STATE/PROV: MAN
LAT: 50 38 N AREA:24530.00 MAX DEPTH: 0.0
LONG: 97 3 W (SQ KM) MEAN DEPTH: 13.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 27

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 17 1947	2
	************		MAY 15 1948	0
	************		MAY 16 1949	1
	************		JUN 1 1950	17
	************		MAY 14 1951	-1
	************		MAY 5 1952	-10
	************		MAY 7 1953	-8
	************		MAY 20 1954	5
	************		MAY 1 1955	-14
	************		MAY 12 1956	-3
	DEC 3 1956	5	MAY 13 1957	-2
	NOV 29 1957	1	MAY 12 1958	-3
	NOV 27 1958	-1	MAY 13 1959	-2
	NOV 20 1959	-8	MAY 7 1960	-8
	NOV 29 1960	1	MAY 14 1961	-1
	NOV 20 1961	-8	MAY 14 1962	-1
	DEC 4 1962	6	MAY 15 1963	0
	DEC 2 1963	4	MAY 15 1964	0
	NOV 27 1964	-1	MAY 17 1965	2
	NOV 25 1965	-3	MAY 18 1966	3
	NOV 16 1966	-12	MAY 21 1967	6
	DEC 4 1967	6	MAY 22 1968	7
	DEC 9 1968	11	MAY 12 1969	-3
	NOV 19 1969	-9	MAY 22 1970	7
	DEC 2 1970	4	MAY 15 1971	0
	NOV 25 1971	-3	MAY 30 1972	15
	DEC 1 1972	3	MAY 12 1973	-3
TOTAL	17		27	
EARLY	NOV 16		MAY 1	
LATE	DEC 9		JUN 1	
MEAN	NOV 28	6.11	MAY 15	6.56

63. NAME OF LAKE: HEMING ID CODE: 040093
STATE/PROV: MAN
LAT: 54 53 N AREA: 2.59 MAX DEPTH: 5.5
LONG: 101. 7 W (SQ KM) MEAN DEPTH: 3.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 21

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		MAY 27 1945	14
************		MAY 1 1946	-12
NOV 1 1946	-4	MAY 22 1947	9
************		MAY 15 1948	2
NOV 4 1948	-1	MAY 4 1949	-9
************		MAY 16 1950	3
************		MAY 12 1951	-1
************		APR 27 1952	-16
OCT 16 1952	-20	MAY 6 1953	-7
NOV 2 1953	-3	MAY 20 1954	7
************		MAY 4 1955	-9
************		MAY 21 1956	8
************		MAY 10 1957	-3
************		MAY 7 1958	-6
NOV 15 1958	10	MAY 24 1959	11
************		MAY 14 1960	1
************		MAY 22 1961	9
************		MAY 17 1962	4
************		MAY 14 1963	1
NOV 14 1963	9	MAY 4 1964	-9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 12 1964	7	***********	
TOTAL	7		20	
EARLY	OCT 16		APR 27	
LATE	NOV 15		MAY 27	
MEAN	NOV 5	9.68	MAY 13	8.25

64. NAME OF LAKE: LYNN ID CODE: 040102
STATE/PROV: MAN
LAT: 56 52 N AREA: 2.59 MAX DEPTH: 0.0
LONG: 101 4 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 10 1969	-6
	OCT 18 1969	-6	MAY 24 1970	8
	NOV 5 1970	12	MAY 13 1971	-3
	OCT 28 1971	4	MAY 15 1972	-1
	OCT 13 1972	-11	***********	
TOTAL	4		4	
EARLY	OCT 13		MAY 10	
LATE	NOV 5		MAY 24	
MEAN	OCT 24	8.90	MAY 16	5.24

65. NAME OF LAKE: ELDON ID CODE: 040112
STATE/PROV: MAN
LAT: 56 52 N AREA: 27.70 MAX DEPTH: 0.0
LONG: 101 4 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 9 1969	-10
	OCT 19 1969	-6	MAY 30 1970	11
	NOV 5 1970	11	MAY 16 1971	-3
	OCT 28 1971	3	MAY 20 1972	1
	OCT 17 1972	-8	***********	
TOTAL	4		4	
EARLY	OCT 17		MAY 9	
LATE	NOV 5		MAY 30	
MEAN	OCT 25	7.58	MAY 19	7.60

66. NAME OF LAKE: LAKE MANITOBA ID CODE: 040123
STATE/PROV: MAN
LAT: 50 9 N AREA: 4710.00 MAX DEPTH: 7.0
LONG: 98 30 W (SQ KM) MEAN DEPTH: 4.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 3

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 30 1956	1	MAY 8 1957	-1
	NOV 29 1957	0	MAY 7 1958	-2
	NOV 27 1958	-2	MAY 11 1959	2
TOTAL	3		3	
EARLY	NOV 27		MAY 7	
LATE	NOV 30		MAY 11	
MEAN	NOV 29	1.29	MAY 9	1.73

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67. NAME OF LAKE: LITTLE PLAYGREEN ID CODE: 040134
STATE/PROV: MAN
LAT: 53 59 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 97 50 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 16 1957	2
	NOV 7 1957	4	************	
	NOV 14 1958	11	MAY 18 1959	4
	OCT 13 1959	-21	************	
	NOV 4 1960	1	************	
	NOV 12 1970	9	MAY 8 1971	-6
	************		MAY 13 1972	-1
	OCT 28 1972	-6	************	
TOTAL	6		4	
EARLY	OCT 13		MAY 8	
LATE	NOV 14		MAY 18	
MEAN	NOV 3	10.77	MAY 14	3.77

68. NAME OF LAKE: LAKE WAHTOPANAH ID CODE: 040144
STATE/PROV: MAN
LAT: 50 1 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 100 19 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 3 1961	0
	NOV 13 1961	-5	APR 29 1962	-4
	NOV 18 1962	0	MAY 1 1963	-2
	NOV 22 1963	4	APR 29 1964	-4
	NOV 19 1964	1	MAY 5 1965	2
	NOV 15 1965	-3	MAY 3 1966	0
	NOV 8 1966	-10	MAY 14 1967	11
	DEC 2 1967	14	APR 29 1968	-4
	NOV 15 1968	-3	APR 25 1969	-8
	NOV 18 1969	0	MAY 8 1970	5
TOTAL	9		10	
EARLY	NOV 8		APR 25	
LATE	DEC 2		MAY 14	
MEAN	NOV 18	6.29	MAY 3	5.16

69. NAME OF LAKE: CLEARWATER ID CODE: 040152
STATE/PROV: MAN
LAT: 54 2 N AREA: 290.00 MAX DEPTH: 32.0
LONG: 101 1 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 1 1956	6	MAY 31 1957	6
	NOV 27 1957	2	MAY 15 1958	-10
	NOV 29 1958	4	************	
	NOV 13 1959	-12	MAY 20 1960	-5
	NOV 25 1960	0	MAY 29 1961	4
	NOV 25 1961	0	MAY 28 1962	3
	DEC 5 1962	10	MAY 24 1963	-1
	DEC 3 1963	8	MAY 19 1964	-6
	NOV 23 1964	-2	MAY 25 1965	0
	NOV 20 1965	-5	MAY 28 1966	3
	NOV 17 1966	-8	JUN 4 1967	10

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 26 1967	1	MAY 26 1968	1
	NOV 29 1968	4	MAY 12 1969	-13
	NOV 20 1969	-5	JUN 5 1970	11
	NOV 28 1970	3	MAY 19 1971	-6
	NOV 25 1971	0	MAY 22 1972	-3
	NOV 19 1972	-6	JUN 1 1973	7
TOTAL	17		16	
EARLY	NOV 13		MAY 12	
LATE	DEC 5		JUN 5	
MEAN	NOV 25	5.66	MAY 25	6.69

70. NAME OF LAKE: GRACE ID CODE: 040164
STATE/PROV: MAN
LAT: 53 50 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 101 10 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 24

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 5 1949	-7
	***********		MAY 20 1950	8
	***********		MAY 2 1951	-10
	***********		MAY 1 1952	-11
	***********		MAY 12 1953	0
	***********		MAY 21 1954	9
	***********		APR 29 1955	-13
	***********		MAY 22 1956	10
	NOV 20 1957	16	***********	
	***********		MAY 12 1959	0
	OCT 11 1959	-24	MAY 12 1960	0
	NOV 7 1960	3	MAY 15 1961	3
	NOV 7 1961	3	MAY 14 1962	2
	NOV 5 1962	1	MAY 9 1963	-3
	NOV 11 1963	7	MAY 8 1964	-4
	NOV 13 1964	9	MAY 11 1965	-1
	NOV 6 1965	2	MAY 18 1966	6
	OCT 29 1966	-6	MAY 25 1967	13
	OCT 27 1967	-8	MAY 10 1968	-2
	NOV 5 1968	1	APR 26 1969	-16
	NOV 19 1969	15	MAY 23 1970	11
	NOV 8 1970	4	MAY 7 1971	-5
	OCT 29 1971	-6	MAY 9 1972	-3
	OCT 17 1972	-18	MAY 15 1973	3
TOTAL	15		23	
EARLY	OCT 11		APR 26	
LATE	NOV 20		MAY 25	
MEAN	NOV 4	10.61	MAY 12	7.67

71. NAME OF LAKE: SETTING ID CODE: 040172
STATE/PROV: MAN
LAT: 54 55 N AREA: 134.80 MAX DEPTH: 25.3
LONG: 98 38 W (SQ KM) MEAN DEPTH: 5.8
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 15

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
NOV 16 1956	1	MAY 30 1957	6
NOV 17 1957	2	MAY 18 1958	-6
NOV 19 1958	4	JUN 1 1959	8
NOV 4 1959	-11	MAY 24 1960	0
NOV 9 1960	-6	MAY 27 1961	3
NOV 9 1961	-6	MAY 26 1962	2
NOV 16 1962	1	MAY 19 1963	-5
NOV 21 1963	6	MAY 15 1964	-9
NOV 20 1964	5	MAY 24 1965	0

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 14 1965	-1	MAY 30 1966	6
	NOV 13 1966	-2	MAY 29 1967	5
	NOV 19 1967	4	MAY 28 1968	4
	NOV 9 1968	-6	MAY 9 1969	-15
	NOV 16 1969	1	MAY 29 1970	5
	NOV 22 1970	7	***********	
TOTAL	15		14	
EARLY	NOV 4		MAY 9	
LATE	NOV 22		JUN 1	
MEAN	NOV 15	5.05	MAY 24	6.45

72. NAME OF LAKE: WINNIPEGOSIS ID CODE: 040183
STATE/PROV: MAN
LAT: 51 39 N AREA: 5460.00 MAX DEPTH: 0.0
LONG: 99 55 W (SQ KM) MEAN DEPTH: 6.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 11

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 8 1946	-5
	NOV 16 1946	4	MAY 16 1947	3
	NOV 9 1947	-3	MAY 19 1948	6
	NOV 12 1948	0	MAY 6 1949	-7
	NOV 18 1949	6	MAY 5 1950	-8
	NOV 10 1950	-2	MAY 12 1951	-1
	OCT 29 1951	-14	MAY 5 1952	-8
	NOV 12 1952	0	MAY 15 1953	2
	NOV 24 1953	12	MAY 20 1954	7
	NOV 14 1954	2	MAY 15 1955	2
	NOV 5 1955	-7	MAY 22 1956	9
TOTAL	10		11	
EARLY	OCT 29		MAY 5	
LATE	NOV 24		MAY 22	
MEAN	NOV 12	6.77	MAY 13	5.92

73. NAME OF LAKE: BRERETON ID CODE: 040193
STATE/PROV: MAN
LAT: 49 54 N AREA: 9.24 MAX DEPTH: 6.4
LONG: 94 35 W (SQ KM) MEAN DEPTH: 4.5
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 15 1958	0
TOTAL	0		1	
EARLY	******		APR 15	
LATE	******		APR 15	
MEAN	******	0.0	APR 15	0.0

74. NAME OF LAKE: CADDY ID CODE: 040203
STATE/PROV: MAN
LAT: 49 49 N AREA: 3.05 MAX DEPTH: 5.8
LONG: 94 43 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 15 1958	0
TOTAL	0		1	
EARLY	******		APR 15	
LATE	******		APR 15	
MEAN	******	0.0	APR 15	0.0

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75. NAME OF LAKE: FALCON ID CODE: 040213
STATE/PROV: MAN
LAT: 49 42 N AREA: 17.80 MAX DEPTH: 23.8
LONG: 95 15 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 27 1952	27
	DEC 1 1952	-3	***********	
	DEC 7 1953	3	***********	
	DEC 17 1954	13	APR 13 1955	-17
	NOV 24 1955	-10	MAY 11 1956	11
	DEC 4 1956	0	MAY 5 1957	5
	NOV 30 1957	-4	APR 17 1958	-13
	***********		APR 17 1959	-13
TOTAL	6		5	
EARLY	NOV 24		APR 13	
LATE	DEC 17		MAY 27	
MEAN	DEC 4	7.11	APR 30	15.82

76. NAME OF LAKE: WEST HAWK ID CODE: 040223
STATE/PROV: MAN
LAT: 49 46 N AREA: 0.0 MAX DEPTH: 111.0
LONG: 95 11 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 26 1954	5	APR 13 1955	-14
	***********		MAY 11 1956	14
	***********		MAY 7 1957	10
	DEC 30 1957	9	APR 17 1958	-10
	DEC 8 1959	-13	***********	
TOTAL	3		4	
EARLY	DEC 8		APR 13	
LATE	DEC 30		MAY 11	
MEAN	DEC 21	9.57	APR 27	12.17

77. NAME OF LAKE: BARRINGTON ID CODE: 040233
STATE/PROV: MAN
LAT: 56 56 N AREA: 165.00 MAX DEPTH: 36.4
LONG: 100 15 W (SQ KM) MEAN DEPTH: 9.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 22 1958	0	***********	
TOTAL	1		0	
EARLY	NOV 22		******	
LATE	NOV 22		******	
MEAN	NOV 22	0.0	******	0.0

78. NAME OF LAKE: CEDAR ID CODE: 040243
STATE/PROV: MAN
LAT: 53 16 N AREA: 1340.00 MAX DEPTH: 0.0
LONG: 100 9 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 28 1958	0	MAY 24 1959	0
TOTAL	1		1	
EARLY	NOV 28		MAY 24	
LATE	NOV 28		MAY 24	
MEAN	NOV 28	0.0	MAY 24	0.0

79. NAME OF LAKE: CROSS ID CODE: 040253
STATE/PROV: MAN
LAT: 54 44 N AREA: 707.00 MAX DEPTH: 0.0
LONG: 97 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 15 1958	0	MAY 19 1959	0
TOTAL	1		1	
EARLY	NOV 15		MAY 19	
LATE	NOV 15		MAY 19	
MEAN	NOV 15	0.0	MAY 19	0.0

80. NAME OF LAKE: GOOSE ID CODE: 040263
STATE/PROV: MAN
LAT: 54 23 N AREA: 137.00 MAX DEPTH: 0.0
LONG: 101 25 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 21 1957	0	************	
	************		MAY 23 1959	0
TOTAL	1		1	
EARLY	DEC 21		MAY 23	
LATE	DEC 21		MAY 23	
MEAN	DEC 21	0.0	MAY 23	0.0

81. NAME OF LAKE: GRANVILLE ID CODE: 040273
STATE/PROV: MAN
LAT: 56 18 N AREA: 469.00 MAX DEPTH: 0.0
LONG: 100 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 22 1958	0	************	
TOTAL	1		0	
EARLY	NOV 22		******	
LATE	NOV 22		******	
MEAN	NOV 22	0.0	******	0.0

82\. NAME OF LAKE: ROCKY — ID CODE: 040303

STATE/PROV: MAN

LAT: 54 9 N	AREA: 0.0	MAX DEPTH:	7.6
LONG: 101 30 W	(SQ KM)	MEAN DEPTH:	5.5
			(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 7 1957	0	MAY 12 1958	0
TOTAL	1		1	
EARLY	NOV 7		MAY 12	
LATE	NOV 7		MAY 12	
MEAN	NOV 7	0.0	MAY 12	0.0

83\. NAME OF LAKE: SOUTH INDIAN — ID CODE: 040313

STATE/PROV: MAN

LAT: 57 20 N	AREA: 2750.00	MAX DEPTH:	20.4
LONG: 98 20 W	(SQ KM)	MEAN DEPTH:	0.0
			(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 9 1957	-9	JUN 11 1958	0
	NOV 26 1958	8	************	
TOTAL	2		1	
EARLY	NOV 9		JUN 11	
LATE	NOV 26		JUN 11	
MEAN	NOV 18	8.51	JUN 11	0.0

84\. NAME OF LAKE: SPLIT — ID CODE: 040323

STATE/PROV: MAN

LAT: 56 13 N	AREA: 284.00	MAX DEPTH:	30.0
LONG: 96 17 W	(SQ KM)	MEAN DEPTH:	7.0
			(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 21 1948	2
	************		MAY 21 1949	2
	************		MAY 30 1950	11
	************		MAY 17 1951	-2
	************		MAY 6 1952	-13
TOTAL	0		5	
EARLY	******		MAY 6	
LATE	******		MAY 30	
MEAN	******	0.0	MAY 19	7.77

85\. NAME OF LAKE: WALKER — ID CODE: 040333

STATE/PROV: MAN

LAT: 54 43 N	AREA: 161.00	MAX DEPTH:	0.0
LONG: 97 0 W	(SQ KM)	MEAN DEPTH:	0.0
			(METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 9 1958	0	MAY 20 1959	0
TOTAL	1		1	
EARLY	NOV 9		MAY 20	
LATE	NOV 9		MAY 20	
MEAN	NOV 9	0.0	MAY 20	0.0

86. NAME OF LAKE: WATERHEN ID CODE: 040343
STATE/PROV: MAN
LAT: 52 7 N AREA: 233.00 MAX DEPTH: 0.0
LONG: 99 35 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 9 1957	0	APR 21 1958	0
TOTAL	1		1	
EARLY	NOV 9		APR 21	
LATE	NOV 9		APR 21	
MEAN	NOV 9	0.0	APR 21	0.0

87. NAME OF LAKE: WHEATCROFT ID CODE: 040353
STATE/PROV: MAN
LAT: 56 49 N AREA: 141.00 MAX DEPTH: 0.0
LONG: 101 1 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 20 1958	0	************	
TOTAL	1		0	
EARLY	NOV 20		******	
LATE	NOV 20		******	
MEAN	NOV 20	0.0	******	0.0

88. NAME OF LAKE: WHITE ID CODE: 040373
STATE/PROV: MAN
LAT: 50 2 N AREA: 6.56 MAX DEPTH: 3.7
LONG: 95 33 W (SQ KM) MEAN DEPTH: 2.6
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 30 1958	12	MAY 2 1959	0
	NOV 5 1959	-13	************	
TOTAL	2		1	
EARLY	NOV 5		MAY 2	
LATE	NOV 30		MAY 2	
MEAN	NOV 18	12.51	MAY 2	0.0

89. NAME OF LAKE: ZED ID CODE: 040383
STATE/PROV: MAN
LAT: 56 55 N AREA: 21.60 MAX DEPTH: 21.3
LONG: 101 24 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 15 1958	0	************	
TOTAL	1		0	
EARLY	NOV 15		******	
LATE	NOV 15		******	
MEAN	NOV 15	0.0	******	0.0

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90. NAME OF LAKE: RICE ID CODE: 040394
STATE/PROV: MAN
LAT: 51 2 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 95 40 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 9 1968	-2	APR 22 1969	-6
	NOV 15 1969	4	MAY 7 1970	9
	NOV 13 1970	2	APR 28 1971	0
	NOV 7 1971	-4	MAY 2 1972	4
	NOV 11 1972	0	APR 19 1973	-9
TOTAL	5		5	
EARLY	NOV 7		APR 19	
LATE	NOV 15		MAY 7	
MEAN	NOV 11	2.83	APR 23	6.54

91. NAME OF LAKE: REINDEER/BROCHET ID CODE: 040402
STATE/PROV: MAN
LAT: 57 53 N AREA: 5569.00 MAX DEPTH: 215.0
LONG: 101 41 W (SQ KM) MEAN DEPTH: 17.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 27

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	OCT 19 1946	-11	JUN 13 1947	8
	NOV 9 1947	10	MAY 31 1948	-5
	NOV 11 1948	12	JUN 3 1949	-2
	OCT 25 1949	-5	JUN 6 1950	1
	OCT 30 1950	0	JUN 5 1951	0
	OCT 21 1951	-9	MAY 19 1952	-17
	NOV 2 1952	3	JUN 8 1953	3
	NOV 1 1953	2	JUN 6 1954	1
	NOV 1 1954	2	MAY 31 1955	-5
	OCT 27 1955	-3	JUN 9 1956	4
	OCT 29 1956	-1	JUN 15 1957	10
	NOV 8 1957	9	MAY 30 1958	-6
	************		JUN 13 1959	8
	OCT 17 1959	-13	JUN 9 1960	4
	OCT 23 1960	-7	JUN 5 1961	0
	OCT 25 1961	-5	JUN 9 1962	4
	NOV 1 1962	2	JUN 7 1963	2
	NOV 15 1963	16	JUN 3 1964	-2
	NOV 9 1964	10	JUN 6 1965	1
	OCT 31 1965	1	JUN 5 1966	0
	OCT 29 1966	-1	JUN 18 1967	13
	NOV 2 1967	3	JUN 4 1968	-1
	NOV 4 1968	5	MAY 26 1969	-10
	OCT 23 1969	-7	JUN 15 1970	10
	NOV 10 1970	11	MAY 28 1971	-8
	OCT 31 1971	1	MAY 28 1972	-8
	OCT 16 1972	-14	MAY 27 1973	-9
TOTAL	26		27	
EARLY	OCT 16		MAY 19	
LATE	NOV 15		JUN 18	
MEAN	OCT 30	7.81	JUN 5	6.82

92. NAME OF LAKE: ISLAND ID CODE: 040414
STATE/PROV: MAN
LAT: 53 52 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 94 40 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 3

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 17 1971	-6
	NOV 27 1971	6	MAY 25 1972	2
	NOV 15 1972	-6	MAY 28 1973	5
TOTAL	2		3	
EARLY	NOV 15		MAY 17	
LATE	NOV 27		MAY 28	
MEAN	NOV 21	6.00	MAY 23	4.65

93. NAME OF LAKE: RANDOLPH ID CODE: 050024
STATE/PROV: ONT
LAT: 50 17 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 88 54 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 4 1969	-10
	NOV 21 1969	-1	MAY 17 1970	3
	NOV 23 1970	1	MAY 20 1971	6
	NOV 22 1971	0	MAY 17 1972	3
	NOV 20 1972	-2	MAY 13 1973	-1
TOTAL	4		5	
EARLY	NOV 20		MAY 4	
LATE	NOV 23		MAY 20	
MEAN	NOV 22	1.22	MAY 14	5.57

94. NAME OF LAKE: NYM ID CODE: 050034
STATE/PROV: ONT
LAT: 48 45 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 91 37 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 24 1966	-1	MAY 15 1967	8
	DEC 1 1967	6	MAY 6 1968	-1
	DEC 7 1968	12	MAY 2 1969	-5
	NOV 20 1969	-5	MAY 8 1970	1
	NOV 27 1970	2	MAY 5 1971	-2
	NOV 22 1971	-3	MAY 11 1972	4
	NOV 16 1972	-9	APR 29 1973	-8
TOTAL	7		7	
EARLY	NOV 16		APR 29	
LATE	DEC 7		MAY 15	
MEAN	NOV 25	6.55	MAY 7	5.00

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95. NAME OF LAKE: PLATEAU ID CODE: 050044
STATE/PROV: ONT
LAT: 48 45 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 91 37 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 24 1966	5	MAY 5 1967	4
	NOV 15 1967	-4	MAY 5 1968	4
	NOV 29 1968	10	APR 28 1969	-3
	NOV 20 1969	1	MAY 5 1970	4
	NOV 10 1970	-9	APR 29 1971	-2
	NOV 21 1970	2	MAY 8 1972	7
	NOV 13 1972	-6	APR 19 1973	-12
TOTAL	7		7	
EARLY	NOV 10		APR 19	
LATE	NOV 29		MAY 8	
MEAN	NOV 19	6.13	MAY 1	6.02

96. NAME OF LAKE: STEEP ROCK ID CODE: 050054
STATE/PROV: ONT
LAT: 48 45 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 91 37 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 7

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 12 1965	-7	MAY 8 1967	8
	NOV 14 1967	-5	APR 29 1968	-1
	NOV 29 1968	10	APR 24 1969	-6
	NOV 20 1969	1	MAY 3 1970	3
	NOV 24 1970	5	APR 29 1971	-1
	NOV 21 1971	2	MAY 7 1972	7
	NOV 13 1972	-6	APR 19 1973	-11
TOTAL	7		7	
EARLY	NOV 12		APR 19	
LATE	NOV 29		MAY 8	
MEAN	NOV 19	5.86	APR 30	6.34

97. NAME OF LAKE: LAKE KENOGAMISIS ID CODE: 050064
STATE/PROV: ONT
LAT: 49 41 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 86 57 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 6

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 8 1967	-7	MAY 12 1968	2
	NOV 17 1968	2	MAY 7 1969	-3
	NOV 20 1969	5	MAY 12 1970	2
	NOV 23 1970	8	MAY 8 1971	-2
	NOV 8 1971	-7	MAY 14 1972	4
	NOV 15 1972	0	MAY 9 1973	-1
TOTAL	6		5	
EARLY	NOV 8		MAY 7	
LATE	NOV 23		MAY 14	
MEAN	NOV 15	5.64	MAY 10	2.52

98. NAME OF LAKE: KENOGAMISIS/BART ID CODE: 050074
STATE/PROV: ONT
LAT: 49 41 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 86 57 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 3

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 13 1967	0	MAY 11 1968	2
	NOV 9 1968	-4	MAY 5 1969	-4
	NOV 18 1969	5	MAY 11 1970	2
TOTAL	3		3	
EARLY	NOV 9		MAY 5	
LATE	NOV 18		MAY 11	
MEAN	NOV 13	3.70	MAY 9	2.83

99. NAME OF LAKE: LAKE OF THE WOOD ID CODE: 050104
STATE/PROV: ONT
LAT: 49 48 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 94 22 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 18

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 16 1956	6
	NOV 24 1956	-4	************	
	DEC 11 1957	13	************	
	************		MAY 8 1959	-2
	NOV 17 1959	-11	MAY 15 1960	5
	DEC 6 1960	8	MAY 15 1961	5
	************		MAY 14 1962	4
	DEC 6 1962	8	MAY 7 1963	-3
	DEC 7 1963	9	MAY 8 1964	-2
	NOV 25 1964	-3	MAY 7 1965	-3
	NOV 26 1965	-2	MAY 11 1966	1
	NOV 21 1966	-7	MAY 12 1967	2
	NOV 28 1967	0	MAY 4 1968	-6
	NOV 29 1968	1	MAY 12 1969	2
	NOV 20 1969	-8	MAY 11 1970	1
	DEC 4 1970	6	APR 29 1971	-11
	NOV 29 1971	1	MAY 10 1972	0
	NOV 22 1972	-6	************	
TOTAL	15		15	
EARLY	NOV 17		APR 29	
LATE	DEC 11		MAY 16	
MEAN	NOV 28	6.90	MAY 10	4.43

100. NAME OF LAKE: ATTAWAPISKAT ID CODE: 050114
STATE/PROV: ONT
LAT: 52 14 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 87 53 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 23

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
NOV 17 1948	7	MAY 11 1949	-12
NOV 1 1949	-9	JUN 2 1950	10
NOV 7 1952	-3	MAY 25 1953	2
NOV 7 1953	-3	************	
************		MAY 7 1955	-16
NOV 14 1955	4	JUN 7 1956	15
NOV 16 1956	6	MAY 23 1957	0
NOV 10 1957	0	MAY 27 1958	4

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 22 1958	12	MAY 26 1959	3
	NOV 3 1959	-7	MAY 22 1960	-1
	NOV 11 1960	1	MAY 27 1961	4
	NOV 7 1961	-3	MAY 24 1962	1
	NOV 8 1962	-2	MAY 23 1963	0
	NOV 26 1963	16	MAY 14 1964	-9
	NOV 19 1964	9	MAY 20 1965	-3
	NOV 7 1965	-3	MAY 27 1966	4
	NOV 2 1966	-8	JUN 4 1967	12
	NOV 7 1967	-3	MAY 19 1968	-4
	NOV 12 1968	2	MAY 17 1969	-6
	OCT 24 1969	-17	MAY 25 1970	2
	NOV 22 1970	12	MAY 19 1971	-4
	NOV 8 1971	-2	MAY 22 1972	-1
	OCT 28 1972	-13	***********	
TOTAL	22		21	
EARLY	OCT 24		MAY 7	
LATE	NOV 26		JUN 7	
MEAN	NOV 10	8.08	MAY 23	7.22

101. NAME OF LAKE: PICKLE ID CODE: 050134
STATE/PROV: ONT
LAT: 51 27 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 90 12 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 3

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 17 1963	1
	NOV 23 1970	6	MAY 14 1971	-2
	NOV 11 1972	-6	***********	
TOTAL	2		2	
EARLY	NOV 11		MAY 14	
LATE	NOV 23		MAY 17	
MEAN	NOV 17	6.00	MAY 16	1.58

102. NAME OF LAKE: RED ID CODE: 050144
STATE/PROV: ONT
LAT: 51 4 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 93 49 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 14

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 16 1956	-6	MAY 5 1957	-4
	NOV 27 1957	5	MAY 4 1958	-5
	NOV 26 1958	4	MAY 12 1959	3
	NOV 27 1959	5	***********	
	***********		MAY 10 1963	1
	DEC 5 1963	13	MAY 6 1964	-3
	NOV 30 1964	8	MAY 17 1965	8
	NOV 9 1966	-13	MAY 23 1967	14
	NOV 15 1967	-7	MAY 5 1968	-4
	***********		APR 30 1969	-9
	NOV 20 1969	-2	MAY 15 1970	6
	NOV 23 1970	1	MAY 6 1971	-3
	NOV 23 1971	1	MAY 9 1972	0
	NOV 13 1972	-9	MAY 8 1973	-1
TOTAL	12		13	
EARLY	NOV 9		APR 30	
LATE	DEC 5		MAY 23	
MEAN	NOV 22	7.30	MAY 9	5.97

103. NAME OF LAKE: PELICAN ID CODE: 050164
STATE/PROV: ONT
LAT: 50 7 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 91 54 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 27

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAY 22 1928	12
	NOV 22 1929	-1	MAY 6 1930	-4
	NOV 26 1930	3	MAY 3 1931	-7
	DEC 5 1931	12	MAY 9 1932	-1
	NOV 15 1932	-8	MAY 7 1933	-3
	NOV 13 1933	-10	MAY 13 1934	3
	DEC 2 1934	9	MAY 8 1935	-2
	NOV 15 1935	-8	MAY 12 1936	2
	NOV 15 1936	-8	MAY 7 1937	-3
	************		MAY 19 1947	9
	DEC 2 1956	9	MAY 8 1957	-2
	NOV 24 1957	1	APR 28 1958	-12
	************		MAY 11 1959	1
	NOV 30 1959	7	MAY 15 1960	5
	NOV 30 1960	7	MAY 14 1961	4
	NOV 27 1961	4	MAY 12 1962	2
	DEC 7 1962	14	MAY 3 1963	-7
	DEC 2 1963	9	MAY 6 1964	-4
	NOV 26 1964	3	MAY 9 1965	-1
	NOV 22 1965	-1	MAY 21 1966	11
	NOV 12 1966	-11	MAY 17 1967	7
	NOV 28 1967	5	MAY 8 1968	-2
	NOV 29 1968	6	MAY 2 1969	-8
	NOV 7 1969	-16	MAY 7 1970	-3
	NOV 17 1970	-6	MAY 9 1971	-1
	NOV 16 1971	-7	MAY 11 1972	1
	NOV 7 1972	-16	************	
TOTAL	24		25	
EARLY	NOV 7		APR 28	
LATE	DEC 7		MAY 22	
MEAN	NOV 23	8.63	MAY 10	5.67

104. NAME OF LAKE: BIG TROUT ID CODE: 050174
STATE/PROV: ONT
LAT: 53 50 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 89 52 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 26

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		JUL 1 1947	23
NOV 19 1947	4	JUN 11 1948	3
NOV 19 1948	4	JUN 8 1949	0
NOV 1 1949	-14	************	
************		JUN 6 1952	-2
NOV 8 1952	-7	JUN 5 1953	-3
NOV 11 1953	-4	JUN 7 1954	-1
NOV 9 1954	-6	MAY 20 1955	-19
NOV 11 1955	-4	JUN 17 1956	9
NOV 15 1956	0	************	
NOV 22 1957	7	JUN 22 1958	14
NOV 30 1958	15	JUN 19 1959	11
NOV 9 1959	-6	MAY 31 1960	-8
NOV 11 1960	-4	JUN 5 1961	-3
NOV 9 1961	-6	JUN 5 1962	-3
NOV 16 1962	1	JUN 17 1963	9
NOV 24 1963	9	MAY 23 1964	-16
NOV 19 1964	4	JUN 5 1965	-3
NOV 9 1965	-6	JUN 5 1966	-3
NOV 10 1966	-5	JUN 18 1967	10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 19 1967	4	JUN 4 1968	-4
	NOV 20 1968	5	JUN 5 1969	-3
	NOV 17 1969	2	JUN 10 1970	2
	NOV 24 1970	9	MAY 30 1971	-9
	NOV 17 1971	2	MAY 29 1972	-10
	NOV 6 1972	-9	JUN 6 1973	-2
TOTAL	24		24	
EARLY	NOV 1		MAY 20	
LATE	NOV 30		JUL 1	
MEAN	NOV 15	6.70	JUN 8	9.27

105. NAME OF LAKE: PICNIC ID CODE: 050204
STATE/PROV: ONT
LAT: 48 36 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 85 17 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 15

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 6 1953	0
	NOV 27 1953	9	MAY 14 1954	8
	NOV 26 1954	8	***********	
	NOV 19 1955	1	MAY 12 1956	6
	***********		MAY 6 1963	0
	NOV 27 1963	9	MAY 2 1964	-4
	NOV 23 1964	5	MAY 6 1965	0
	NOV 9 1965	-9	MAY 16 1966	10
	NOV 5 1966	-13	MAY 7 1967	1
	NOV 14 1967	-4	APR 30 1968	-6
	NOV 16 1968	-2	MAY 6 1969	0
	OCT 28 1969	-21	APR 20 1970	-16
	NOV 15 1970	-3	MAY 7 1971	1
	DEC 13 1971	25	MAY 11 1972	5
	NOV 16 1972	-2	***********	
TOTAL	13		13	
EARLY	OCT 28		APR 20	
LATE	DEC 13		MAY 16	
MEAN	NOV 18	11.10	MAY 6	6.42

106. NAME OF LAKE: TOOKENAY ID CODE: 050214
STATE/PROV: ONT
LAT: 48 36 N AREA: 0.0 MAX DEPTH: 0.0
LONG: 85 17 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 15

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	***********		MAY 10 1953	-2
	***********		MAY 20 1954	8
	***********		APR 28 1955	-14
	***********		MAY 17 1956	5
	DEC 7 1962	3	MAY 12 1963	0
	NOV 30 1963	-4	MAY 6 1964	-6
	DEC 10 1964	6	MAY 10 1965	-2
	DEC 12 1965	8	MAY 15 1966	3
	NOV 20 1966	-14	MAY 16 1967	4
	DEC 4 1967	0	MAY 7 1968	-5
	NOV 29 1968	-5	MAY 11 1969	-1
	DEC 1 1969	-3	MAY 15 1970	3
	DEC 6 1970	2	MAY 14 1971	2
	DEC 18 1971	14	MAY 14 1972	2
	NOV 29 1972	-5	***********	
TOTAL	11		14	
EARLY	NOV 20		APR 28	
LATE	DEC 18		MAY 20	
MEAN	DEC 4	7.26	MAY 12	5.33

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107. NAME OF LAKE: SENACHWINE ID CODE: 060041
STATE/PROV: ILL
LAT: 41 10 N AREA: 13.47 MAX DEPTH: 0.0
LONG: 89 21 W (SQ KM) MEAN DEPTH: 1.8
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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108. NAME OF LAKE: GOOSE ID CODE: 060051
STATE/PROV: ILL
LAT: 41 14 N AREA: 9.56 MAX DEPTH: 0.0
LONG: 89 23 W (SQ KM) MEAN DEPTH: 1.8
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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109. NAME OF LAKE: PISTAKEE ID CODE: 060061
STATE/PROV: ILL
LAT: 42 23 N AREA: 6.28 MAX DEPTH: 0.0
LONG: 88 12 W (SQ KM) MEAN DEPTH: 3.3
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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110. NAME OF LAKE: HORSESHOE ID CODE: 060071
STATE/PROV: ILL
LAT: 38 42 N AREA: 8.80 MAX DEPTH: 0.0
LONG: 90 5 W (SQ KM) MEAN DEPTH: 2.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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111. NAME OF LAKE: CHAUTAUQUA ID CODE: 060081
STATE/PROV: ILL
LAT: 40 22 N AREA: 14.40 MAX DEPTH: 0.0
LONG: 90 0 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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112. NAME OF LAKE: SPRING, ID CODE: 060091
STATE/PROV: ILL
LAT: 42 2 N AREA: 14.40 MAX DEPTH: 0.0
LONG: 90 8 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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113. NAME OF LAKE: FOX ID CODE: 060101
STATE/PROV: ILL
LAT: 42 25 N AREA: 6.77 MAX DEPTH: 0.0
LONG: 88 9 W (SQ KM) MEAN DEPTH: 2.4
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

114. NAME OF LAKE: CALUMET — ID CODE: 060111
STATE/PROV: ILL
LAT: 41 40 N — AREA: 6.48 (SQ KM) — MAX DEPTH: 0.0
LONG: 87 35 W — MEAN DEPTH: 2.4 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

115. NAME OF LAKE: CLEAR — ID CODE: 060141
STATE/PROV: ILL
LAT: 40 25 N — AREA: 5.93 (SQ KM) — MAX DEPTH: 0.0
LONG: 89 57 W — MEAN DEPTH: 1.2 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

116. NAME OF LAKE: VERMILLION — ID CODE: 060151
STATE/PROV: ILL
LAT: 40 11 N — AREA: 2.84 (SQ KM) — MAX DEPTH: 0.0
LONG: 87 38 W — MEAN DEPTH: 2.3 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

117. NAME OF LAKE: WAWASEE — ID CODE: 070021
STATE/PROV: IND
LAT: 41 24 N — AREA: 11.61 (SQ KM) — MAX DEPTH: 23.0
LONG: 85 42 W — MEAN DEPTH: 6.7 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

118. NAME OF LAKE: WINONA — ID CODE: 070031
STATE/PROV: IND
LAT: 41 13 N — AREA: 2.13 (SQ KM) — MAX DEPTH: 24.1
LONG: 85 50 W — MEAN DEPTH: 9.1 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

119. NAME OF LAKE: CEDAR — ID CODE: 070051
STATE/PROV: IND
LAT: 41 22 N — AREA: 3.16 (SQ KM) — MAX DEPTH: 4.9
LONG: 87 26 W — MEAN DEPTH: 2.4 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

120. NAME OF LAKE: SYRACUSE — ID CODE: 070061
STATE/PROV: IND
LAT: 41 25 N — AREA: 1.68 (SQ KM) — MAX DEPTH: 10.4
LONG: 85 44 W — MEAN DEPTH: 4.0 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

121. NAME OF LAKE: MAC BRIDE   ID CODE: 080051
STATE/PROV: IWA
LAT: 41 48 N   AREA: 3.89   MAX DEPTH: 11.2
LONG: 91 34 W   (SQ KM)   MEAN DEPTH: 1.5
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

122. NAME OF LAKE: CORALVILLE   ID CODE: 080061
STATE/PROV: IWA
LAT: 41 43 N   AREA: 19.85   MAX DEPTH: 9.1
LONG: 91 32 W   (SQ KM)   MEAN DEPTH: 3.4
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

123. NAME OF LAKE: RED ROCK   ID CODE: 080071
STATE/PROV: IWA
LAT: 41 22 N   AREA: 25.50   MAX DEPTH: 10.7
LONG: 92 59 W   (SQ KM)   MEAN DEPTH: 2.4
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

124. NAME OF LAKE: RATHBUN   ID CODE: 080081
STATE/PROV: IWA
LAT: 40 50 N   AREA: 44.60   MAX DEPTH: 16.5
LONG: 92 54 W   (SQ KM)   MEAN DEPTH: 5.9
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

125. NAME OF LAKE: UNION   ID CODE: 090071
STATE/PROV: MCH
LAT: 42 3 N   AREA: 1.88   MAX DEPTH: 0.0
LONG: 85 12 W   (SQ KM)   MEAN DEPTH: 8.7
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

126. NAME OF LAKE: BEAR   ID CODE: 090103
STATE/PROV: MCH
LAT: 44 48 N   AREA: 0.47   MAX DEPTH: 16.2
LONG: 84 37 W   (SQ KM)   MEAN DEPTH: 5.2
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 5

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
DEC 18 1949	-3	MAR 25 1950	19
DEC 15 1950	-6	MAR 1 1951	-5

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 22 1951	1	MAR 12 1952	6
	DEC 30 1952	9	FEB 28 1953	-6
	DEC 20 1953	-1	FEB 22 1954	-12
TOTAL	5		5	
EARLY	DEC 15		FEB 22	
LATE	DEC 30		MAR 25	
MEAN	DEC 21	5.06	MAR 6	10.97

127. NAME OF LAKE: BIG PORTAGE ID CODE: 090113
STATE/PROV: MCH
LAT: 42 19 N AREA: 1.46 MAX DEPTH: 12.2
LONG: 84 15 W (SQ KM) MEAN DEPTH: 3.3
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 18 1949	-4	MAR 25 1950	14
	DEC 12 1950	-10	MAR 5 1951	-6
	DEC 20 1951	-2	MAR 13 1952	2
	DEC 28 1952	6	FEB 26 1953	-13
	DEC 22 1953	0	FEB 22 1954	-17
	DEC 16 1954	-6	MAR 10 1955	-1
	DEC 15 1955	-7	MAR 16 1956	5
	JAN 1 1957	10	MAR 12 1957	1
	JAN 1 1958	10	MAR 25 1958	14
TOTAL	9		9	
EARLY	DEC 12		FEB 22	
LATE	JAN 1		MAR 25	
MEAN	DEC 22	7.00	MAR 11	10.09

128. NAME OF LAKE: FINE ID CODE: 090133
STATE/PROV: MCH
LAT: 42 27 N AREA: 1.30 MAX DEPTH: 14.5
LONG: 85 17 W (SQ KM) MEAN DEPTH: 3.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 9

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 17 1949	-4	MAR 26 1950	10
	DEC 16 1950	-5	MAR 2 1951	-14
	DEC 20 1951	-1	MAR 22 1952	6
	JAN 1 1953	11	MAR 13 1953	-3
	DEC 27 1953	6	MAR 2 1954	-14
	DEC 18 1954	-3	MAR 12 1955	-4
	DEC 8 1955	-13	MAR 31 1956	15
	JAN 2 1957	12	MAR 13 1957	-3
	DEC 14 1957	-7	MAR 26 1958	10
TOTAL	9		9	
EARLY	DEC 8		MAR 2	
LATE	JAN 2		MAR 31	
MEAN	DEC 21	7.96	MAR 16	9.93

129. NAME OF LAKE: MUSKEGON ID CODE: 090211
STATE/PROV: MCH
LAT: 43 14 N AREA: 16.81 MAX DEPTH: 21.4
LONG: 86 18 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

130. NAME OF LAKE: BIG STONE ID CODE: 100031
STATE/PROV: MIN
LAT: 45 19 N AREA: 50.25 MAX DEPTH: 0.0
LONG: 96 27 W (SQ KM) MEAN DEPTH: 3.4
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

131. NAME OF LAKE: BUFFALO ID CODE: 100041
STATE/PROV: MIN
LAT: 45 10 N AREA: 6.12 MAX DEPTH: 9.1
LONG: 93 54 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

132. NAME OF LAKE: SHAGAWA ID CODE: 100051
STATE/PROV: MIN
LAT: 47 55 N AREA: 10.70 MAX DEPTH: 14.5
LONG: 91 54 W (SQ KM) MEAN DEPTH: 6.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

133. NAME OF LAKE: HAGEN ID CODE: 110031
STATE/PROV: NEB
LAT: 42 20 N AREA: 1.26 MAX DEPTH: 1.5
LONG: 99 44 W (SQ KM) MEAN DEPTH: 0.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

134. NAME OF LAKE: MOON ID CODE: 110041
STATE/PROV: NEB
LAT: 42 23 N AREA: 1.86 MAX DEPTH: 2.4
LONG: 100 8 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

135. NAME OF LAKE: WILLOW ID CODE: 110051
STATE/PROV: NEB
LAT: 42 14 N AREA: 1.27 MAX DEPTH: 2.2
LONG: 100 5 W (SQ KM) MEAN DEPTH: 1.4
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

136. NAME OF LAKE: BIG ALKALI ID CODE: 110091
STATE/PROV: NEB
LAT: 42 38 N AREA: 3.41 MAX DEPTH: 3.0
LONG: 100 37 W (SQ KM) MEAN DEPTH: 1.5
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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137. NAME OF LAKE: DADS ID CODE: 110111
STATE/PROV: NEB
LAT: 42 30 N AREA: 4.15 MAX DEPTH: 3.4
LONG: 100 40 W (SQ KM) MEAN DEPTH: 1.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

138. NAME OF LAKE: MARSH ID CODE: 110151
STATE/PROV: NEB
LAT: 42 30 N AREA: 9.31 MAX DEPTH: 2.4
LONG: 100 30 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

139. NAME OF LAKE: PELICAN ID CODE: 110191
STATE/PROV: NEB
LAT: 42 32 N AREA: 3.32 MAX DEPTH: 2.3
LONG: 100 39 W (SQ KM) MEAN DEPTH: 1.3
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

140. NAME OF LAKE: RED DEER ID CODE: 110201
STATE/PROV: NEB
LAT: 42 34 N AREA: 1.34 MAX DEPTH: 1.0
LONG: 100 29 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

141. NAME OF LAKE: SWAN ID CODE: 110211
STATE/PROV: NEB
LAT: 42 14 N AREA: 1.43 MAX DEPTH: 2.1
LONG: 100 46 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

142. NAME OF LAKE: TROUT ID CODE: 110221
STATE/PROV: NEB
LAT: 42 35 N AREA: 2.14 MAX DEPTH: 2.0
LONG: 100 37 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

143. NAME OF LAKE: CRESCENT ID CODE: 110251
STATE/PROV: NEB
LAT: 41 42 N AREA: 3.98 MAX DEPTH: 1.5
LONG: 102 24 W (SQ KM) MEAN DEPTH: 0.5
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

144. NAME OF LAKE: GOOSE ID CODE: 110261
STATE/PROV: NEB
LAT: 41 47 N AREA: 1.47 MAX DEPTH: 1.7
LONG: 102 27 W (SQ KM) MEAN DEPTH: 1.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

145. NAME OF LAKE: ISLAND ID CODE: 110281
STATE/PROV: NEB
LAT: 41 44 N AREA: 2.88 MAX DEPTH: 2.1
LONG: 102 24 W (SQ KM) MEAN DEPTH: 1.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

146. NAME OF LAKE: GEORGE ID CODE: 110291
STATE/PROV: NEB
LAT: 41 59 N AREA: 1.53 MAX DEPTH: 1.8
LONG: 101 50 W (SQ KM) MEAN DEPTH: 1.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

147. NAME OF LAKE: SWAN ID CODE: 110311
STATE/PROV: NEB
LAT: 41 43 N AREA: 1.52 MAX DEPTH: 1.8
LONG: 102 30 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

148. NAME OF LAKE: ASHTABULA ID CODE: 120011
STATE/PROV: NDA
LAT: 47 10 N AREA: 3.61 MAX DEPTH: 15.3
LONG: 98 0 W (SQ KM) MEAN DEPTH: 4.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

149. NAME OF LAKE: SPIRITWOOD ID CODE: 120021
STATE/PROV: NDA
LAT: 47 11 N AREA: 2.85 MAX DEPTH: 14.6
LONG: 98 50 W (SQ KM) MEAN DEPTH: 7.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

150. NAME OF LAKE: SAKAKAWEA ID CODE: 120031
STATE/PROV: NDA
LAT: 47 35 N AREA: 1326.00 MAX DEPTH: 52.2
LONG: 101 25 W (SQ KM) MEAN DEPTH: 18.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

151. NAME OF LAKE: HEART BUTTE ID CODE: 120051
STATE/PROV: NDA
LAT: 46 36 N AREA: 13.78 MAX DEPTH: 18.4
LONG: 101 50 W (SQ KM) MEAN DEPTH: 6.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

152. NAME OF LAKE: JAMESTOWN ID CODE: 120061
STATE/PROV: NDA
LAT: 46 56 N AREA: 8.51 MAX DEPTH: 13.4
LONG: 98 42 W (SQ KM) MEAN DEPTH: 4.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

153. NAME OF LAKE: BIG STONE ID CODE: 130011
STATE/PROV: SDA
LAT: 45 18 N AREA: 85.50 MAX DEPTH: 4.5
LONG: 96 28 W (SQ KM) MEAN DEPTH: 3.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

154. NAME OF LAKE: LAKE HERMAN ID CODE: 130021
STATE/PROV: SDA
LAT: 44 0 N AREA: 5.47 MAX DEPTH: 2.4
LONG: 97 10 W (SQ KM) MEAN DEPTH: 1.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

155. NAME OF LAKE: LAKE MADISON ID CODE: 130031
STATE/PROV: SDA
LAT: 43 57 N AREA: 12.16 MAX DEPTH: 5.2
LONG: 97 0 W (SQ KM) MEAN DEPTH: 2.4
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

156. NAME OF LAKE: LAKE KAMPESKA ID CODE: 130041
STATE/PROV: SDA
LAT: 44 55 N AREA: 12.16 MAX DEPTH: 5.5
LONG: 97 12 W (SQ KM) MEAN DEPTH: 3.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

157. NAME OF LAKE: LAKE POINSETT ID CODE: 130051
STATE/PROV: SDA
LAT: 44 34 N AREA: 32.40 MAX DEPTH: 5.5
LONG: 97 5 W (SQ KM) MEAN DEPTH: 1.8
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

158. NAME OF LAKE: LAKE ANDES ID CODE: 130061
STATE/PROV: SDA
LAT: 43 9 N AREA: 18.62 MAX DEPTH: 4.9
LONG: 98 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

159. NAME OF LAKE: LAKE OAHE ID CODE: 130071
STATE/PROV: SDA
LAT: 44 28 N AREA: 1317.00 MAX DEPTH: 58.8
LONG: 100 30 W (SQ KM) MEAN DEPTH: 18.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

160. NAME OF LAKE: LAKE SHARPE ID CODE: 130081
STATE/PROV: SDA
LAT: 43 48 N AREA: 231.00 MAX DEPTH: 23.8
LONG: 99 23 W (SQ KM) MEAN DEPTH: 9.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

161. NAME OF LAKE: FRANCIS CASE ID CODE: 130091
STATE/PROV: SDA
LAT: 43 4 N AREA: 271.00 MAX DEPTH: 30.5
LONG: 98 35 W (SQ KM) MEAN DEPTH: 12.2
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

162. NAME OF LAKE: LEWIS & CLARK ID CODE: 130101
STATE/PROV: SDA
LAT: 42 51 N AREA: 121.50 MAX DEPTH: 14.5
LONG: 97 30 W (SQ KM) MEAN DEPTH: 4.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

163. NAME OF LAKE: SHADEHILL ID CODE: 130111
STATE/PROV: SDA
LAT: 45 45 N AREA: 14.58 MAX DEPTH: 13.3
LONG: 102 13 W (SQ KM) MEAN DEPTH: 2.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

164. NAME OF LAKE: BEAVER DAM ID CODE: 140013
STATE/PROV: WIS
LAT: 43 30 N AREA: 26.75 MAX DEPTH: 2.1
LONG: 88 52 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 3 1958	0
TOTAL	0		1	
EARLY	******		APR 3	
LATE	******		APR 3	
MEAN	******	0.0	APR 3	0.0

165. NAME OF LAKE: ARBOR VITAE ID CODE: 140023
STATE/PROV: WIS
LAT: 45 58 N AREA: 4.32 MAX DEPTH: 13.7
LONG: 89 39 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 30 1958	7	APR 20 1959	0
	NOV 16 1959	-7	************	
TOTAL	2		1	
EARLY	NOV 16		APR 20	
LATE	NOV 30		APR 20	
MEAN	NOV 23	7.00	APR 20	0.0

166. NAME OF LAKE: CAMP ID CODE: 140043
STATE/PROV: WIS
LAT: 42 32 N AREA: 1.87 MAX DEPTH: 5.2
LONG: 88 8 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAR 31 1950	-2
	NOV 29 1958	0	APR 3 1959	1
TOTAL	1		2	
EARLY	NOV 29		MAR 31	
LATE	NOV 29		APR 3	
MEAN	NOV 29	0.0	APR 2	1.58

167. NAME OF LAKE: CHAIN-O-LAKES ID CODE: 140053
STATE/PROV: WIS
LAT: 44 20 N AREA: 0.21 MAX DEPTH: 16.9
LONG: 89 10 W (SQ KM) MEAN DEPTH: 6.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 20 1951	-12	APR 19 1952	4
	NOV 29 1952	-3	APR 8 1953	-7
	DEC 17 1953	15	APR 10 1954	-5
	DEC 6 1954	4	APR 9 1955	-6
	NOV 30 1955	-2	APR 21 1956	6
	NOV 29 1956	-3	APR 19 1957	4
	DEC 1 1957	-1	APR 10 1958	-5
	NOV 30 1958	-2	APR 20 1959	5
TOTAL	8		8	
EARLY	NOV 20		APR 8	
LATE	DEC 17		APR 21	
MEAN	DEC 2	7.18	APR 15	5.34

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168. NAME OF LAKE: DEVILS ID CODE: 140073
STATE/PROV: WIS
LAT: 43 25 N AREA: 1.46 MAX DEPTH: 13.1
LONG: 89 44 W (SQ KM) MEAN DEPTH: 8.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 29 1941	12	************	
	DEC 18 1946	1	APR 13 1947	6
	DEC 13 1947	-4	MAR 29 1948	-9
	DEC 25 1948	8	APR 4 1949	-3
	DEC 23 1949	6	************	
	DEC 4 1950	-13	************	
	************		APR 2 1954	-5
	************		APR 9 1955	2
	DEC 5 1955	-12	************	
	************		APR 15 1959	8
TOTAL	7		6	
EARLY	DEC 4		MAR 29	
LATE	DEC 29		APR 15	
MEAN	DEC 17	9.06	APR 7	6.04

169. NAME OF LAKE: GENEVA ID CODE: 140093
STATE/PROV: WIS
LAT: 42 34 N AREA: 21.30 MAX DEPTH: 41.2
LONG: 88 30 W (SQ KM) MEAN DEPTH: 19.7
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 85

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
JAN 7 1863	5	APR 1 1863	2
DEC 18 1863	-15	APR 8 1864	9
DEC 8 1864	-25	APR 2 1865	3
DEC 16 1865	-17	APR 17 1866	18
DEC 27 1866	-6	APR 18 1867	19
DEC 31 1867	-2	MAR 25 1868	-5
DEC 11 1868	-22	MAR 16 1869	-14
DEC 21 1869	-12	APR 12 1870	13
DEC 24 1870	-9	MAR 20 1871	-10
DEC 9 1871	-24	APR 15 1872	16
DEC 4 1872	-29	APR 8 1873	9
DEC 21 1873	-12	APR 12 1874	13
DEC 20 1874	-13	APR 15 1875	16
DEC 27 1875	-6	APR 10 1876	11
DEC 6 1876	-27	APR 13 1877	14
JAN 7 1878	5	FEB 21 1878	-37
DEC 23 1878	-10	APR 13 1879	14
DEC 18 1879	-15	MAR 3 1880	-27
NOV 23 1880	-40	MAY 6 1881	37
JAN 2 1882	0	MAR 1 1882	-29
DEC 16 1882	-17	APR 13 1883	14
DEC 19 1883	-14	APR 13 1884	14
DEC 31 1884	-2	APR 20 1885	21
DEC 7 1885	-26	JAN 3 1886	-86
DEC 19 1886	-14	APR 2 1887	3
DEC 28 1887	-5	APR 12 1888	13
JAN 11 1889	9	MAR 31 1889	1
JAN 17 1890	15	APR 9 1890	10
JAN 3 1891	1	APR 13 1891	14
JAN 3 1892	1	APR 2 1892	3
DEC 20 1892	-13	APR 5 1893	6
DEC 7 1893	-26	MAR 11 1894	-19
************		APR 6 1895	7
DEC 6 1895	-27	APR 6 1896	7
JAN 18 1897	16	APR 7 1897	8
DEC 17 1897	-16	MAR 25 1898	-5
DEC 8 1898	-25	APR 14 1899	15

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 29 1899	-4	APR 17 1900	18
	************		APR 11 1901	12
	JAN 19 1902	17	MAR 15 1902	-15
	JAN 18 1903	16	MAR 18 1903	-12
	DEC 16 1903	-17	APR 15 1904	16
	JAN 5 1905	3	MAR 28 1905	-2
	JAN 23 1906	21	APR 9 1906	10
	JAN 23 1907	21	MAR 24 1907	-6
	JAN 28 1908	26	MAR 26 1908	-4
	JAN 7 1909	5	APR 5 1909	6
	DEC 28 1909	-5	MAR 24 1910	-6
	JAN 3 1911	1	MAR 25 1911	-5
	JAN 2 1912	0	APR 13 1912	14
	JAN 8 1913	6	MAR 29 1913	-1
	FEB 5 1914	34	APR 1 1914	2
	DEC 24 1914	-9	APR 9 1915	10
	JAN 13 1916	11	APR 2 1916	3
	DEC 26 1917	-7	MAR 31 1917	1
	DEC 15 1917	-18	MAR 30 1918	0
	FEB 10 1919	39	MAR 12 1919	-18
	DEC 16 1919	-17	MAR 26 1920	-4
	JAN 12 1921	10	FEB 15 1921	-43
	JAN 22 1922	20	MAR 25 1922	-5
	JAN 23 1923	21	APR 15 1923	16
	JAN 14 1924	12	APR 9 1924	10
	DEC 28 1924	-5	MAR 26 1925	-4
	DEC 29 1925	-4	APR 20 1925	21
	DEC 28 1925	-5	MAR 14 1927	-16
	JAN 27 1928	25	MAR 24 1928	-6
	JAN 15 1929	13	MAR 27 1929	-3
	DEC 23 1929	-10	MAR 17 1930	-13
	JAN 15 1931	13	MAR 26 1931	-4
	MAR 10 1932	67	MAR 30 1932	0
	FEB 8 1933	37	APR 2 1933	3
	FEB 2 1934	31	APR 3 1934	4
	JAN 18 1935	16	MAR 21 1935	-9
	DEC 27 1935	-6	MAR 26 1936	-4
	JAN 10 1937	8	APR 13 1937	14
	JAN 9 1938	7	MAR 12 1938	-18
	FEB 4 1939	33	MAR 27 1939	-3
	JAN 7 1940	5	APR 15 1940	16
	JAN 21 1941	19	APR 10 1941	11
	JAN 10 1942	8	APR 4 1942	5
	JAN 19 1943	17	MAR 31 1943	1
	JAN 7 1944	5	FEB 13 1944	-45
	JAN 10 1945	8	MAR 16 1945	-14
	DEC 24 1945	-9	MAR 17 1946	-13
	DEC 17 1950	-16	APR 9 1951	10
TOTAL	83		85	
EARLY	NOV 23		JAN 3	
LATE	MAR 10		MAY 6	
MEAN	JAN 2	18.53	MAR 30	17.18

170. NAME OF LAKE: ISLAND ID CODE: 140103

STATE/PROV: WIS

LAT: 46 8 N AREA: 3.07 MAX DEPTH: 10.1

LONG: 89 47 W (SQ KM) MEAN DEPTH: 0.0

(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 10

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		APR 21 1949	-4
NOV 19 1949	-4	MAY 13 1950	18
************		MAY 3 1951	8
************		APR 25 1952	0
NOV 22 1952	-1	APR 16 1953	-9
NOV 27 1953	4	APR 21 1954	-4
NOV 30 1954	7	APR 18 1955	-7
************		APR 23 1956	-2
NOV 17 1956	-6	APR 24 1957	-1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 25 1957	2	************	
TOTAL	6		9	
EARLY	NOV 17		APR 16	
LATE	NOV 30		MAY 13	
MEAN	NOV 23	4.51	APR 25	7.85

171. NAME OF LAKE: KEGONSA ID CODE: 140123
STATE/PROV: WIS
LAT: 42 58 N AREA: 11.00 MAX DEPTH: 9.5
LONG: 89 15 W (SQ KM) MEAN DEPTH: 4.5
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 32

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 1 1905	-3
	DEC 3 1905	-8	APR 7 1906	9
	DEC 7 1906	-4	MAR 25 1907	-4
	DEC 5 1907	-6	MAR 25 1908	-4
	DEC 9 1909	-2	************	
	************		MAR 21 1911	-8
	************		APR 10 1912	12
	DEC 11 1912	0	************	
	************		MAR 31 1922	2
	DEC 9 1922	-2	************	
	************		APR 18 1924	20
	DEC 8 1924	-3	************	
	DEC 28 1927	17	MAR 23 1928	-6
	************		MAR 28 1929	-1
	DEC 5 1929	-6	************	
	************		APR 1 1934	3
	DEC 28 1934	17	************	
	************		MAR 28 1936	-1
	DEC 8 1937	-3	MAR 16 1938	-13
	************		MAR 31 1939	2
	DEC 28 1939	17	APR 16 1940	18
	************		MAR 24 1942	-5
	DEC 10 1942	-1	APR 5 1943	7
	DEC 7 1944	-4	************	
	************		MAR 21 1946	-8
	DEC 2 1945	-9	************	
	DEC 1 1947	-10	MAR 29 1948	0
	************		MAR 25 1949	-4
	DEC 23 1949	12	************	
	************		MAR 21 1953	-8
	DEC 7 1953	-4	MAR 15 1954	-14
	************		APR 3 1955	5
TOTAL	18		23	
EARLY	DEC 1		MAR 15	
LATE	DEC 28		APR 18	
MEAN	DEC 11	8.83	MAR 29	8.64

172. NAME OF LAKE: MENDOTA ID CODE: 140153
STATE/PROV: WIS
LAT: 43 7 N AREA: 39.40 MAX DEPTH: 25.6
LONG: 89 25 W (SQ KM) MEAN DEPTH: 12.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 107

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		APR 5 1853	-1
DEC 27 1853	7	************	
DEC 18 1855	-2	APR 14 1856	8
DEC 6 1856	-14	MAY 6 1857	30
NOV 25 1857	-25	MAR 26 1858	-11
DEC 8 1858	-12	MAR 14 1859	-23

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
~~DEC 7 1859~~	~~-13~~	~~MAR 26 1860~~	~~-11~~
DEC 14 1860	-6	APR 10 1861	4
DEC 2 1861	-18	APR 13 1862	7
~~DEC 26 1862~~	~~6~~	~~APR 9 1863~~	~~3~~
DEC 18 1863	-2	APR 21 1864	15
DEC 8 1864	-12	APR 5 1865	-1
DEC 14 1855	-6	APR 18 1866	12
DEC 18 1866	-2	APR 20 1867	14
~~DEC 12 1867~~	~~-8~~	~~MAR 31 1868~~	~~-6~~
DEC 10 1868	-10	APR 16 1869	10
DEC 2 1869	-18	APR 12 1870	6
~~DEC 24 1870~~	~~4~~	~~APR 2 1871~~	~~-4~~
DEC 19 1871	-1	APR 23 1872	17
NOV 30 1872	-20	APR 23 1873	17
NOV 29 1873	-21	APR 14 1874	8
DEC 10 1874	-10	APR 15 1875	9
~~JAN 10 1876~~	~~21~~	~~APR 10 1876~~	~~4~~
DEC 8 1876	-12	APR 17 1877	11
JAN 6 1878	17	MAR 9 1878	-28
~~DEC 21 1878~~	~~1~~	~~APR 12 1879~~	~~6~~
DEC 17 1879	-3	MAR 25 1880	-12
NOV 23 1980	-27	MAY 3 1881	27
JAN 2 1882	13	MAR 21 1882	-16
DEC 10 1882	-10	APR 13 1883	7
~~DEC 18 1883~~	~~-2~~	~~APR 15 1884~~	~~9~~
DEC 17 1884	-3	APR 20 1885	14
DEC 12 1885	-8	APR 19 1886	13
~~DEC 5 1886~~	~~-15~~	~~APR 15 1887~~	~~9~~
DEC 24 1887	4	APR 15 1888	9
JAN 2 1889	13	MAR 31 1889	-6
JAN 14 1890	25	MAR 30 1890	-7
DEC 26 1890	6	APR 16 1891	10
~~DEC 27 1891~~	~~7~~	~~APR 2 1892~~	~~-4~~
DEC 16 1892	-4	APR 7 1893	1
DEC 4 1893	-16	MAR 15 1894	-22
~~DEC 28 1894~~	~~3~~	~~APR 8 1895~~	~~2~~
JAN 5 1896	16	APR 5 1896	-1
DEC 21 1896	1	APR 10 1897	4
DEC 17 1897	-3	MAR 27 1898	-10
DEC 9 1898	-11	APR 18 1899	12
~~DEC 27 1899~~	~~7~~	APR 17 1900	11
DEC 25 1900	5	APR 11 1901	5
DEC 15 1901	-5	MAR 30 1902	-7
~~DEC 25 1902~~	~~5~~	~~MAR 24 1903~~	~~-13~~
DEC 13 1903	-7	MAR 17 1904	-20
DEC 14 1904	-6	APR 1 1905	-5
JAN 1 1906	12	APR 8 1906	2
DEC 20 1906	0	MAR 24 1907	-13
~~JAN 1 1908~~	~~12~~	~~MAR 24 1908~~	-13
DEC 22 1908	2	APR 7 1909	1
DEC 14 1909	-6	MAR 26 1910	-11
~~DEC 9 1910~~	~~-11~~	~~MAR 20 1911~~	~~-17~~
DEC 28 1911	8	APR 14 1912	8
DEC 24 1912	4	APR 2 1913	-4
JAN 12 1914	23	APR 10 1914	4
DEC 16 1914	-4	APR 10 1915	4
~~DEC 28 1915~~	~~8~~	~~APR 8 1916~~	2
DEC 16 1916	-4	APR 11 1917	5
DEC 11 1917	-9	APR 5 1918	-1
~~JAN 3 1919~~	~~14~~	~~MAR 26 1919~~	~~-11~~
DEC 9 1919	-11	MAR 28 1920	-9
DEC 25 1920	5	MAR 16 1921	-21
DEC 25 1921	5	MAR 31 1922	-6
DEC 16 1922	-4	APR 20 1923	14
JAN 1 1924	12	APR 14 1924	8
DEC 19 1924	-1	APR 3 1925	-3
DEC 16 1925	-4	APR 19 1926	13
~~DEC 6 1926~~	~~-14~~	~~MAR 19 1927~~	-18
DEC 17 1927	-3	APR 1 1928	-5
DEC 21 1928	1	MAR 27 1929	-10
DEC 3 1929	-17	APR 20 1930	14
DEC 16 1930	-4	APR 24 1931	18
~~JAN 30 1932~~	~~41~~	~~APR 4 1932~~	-2
DEC 10 1932	-10	APR 4 1933	-2
DEC 25 1933	5	MAR 26 1934	-11

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 24 1934	4	MAR 28 1935	-9
	DEC 20 1935	0	MAR 30 1936	-7
	JAN 5 1937	16	APR 13 1937	7
	DEC 7 1937	-13	MAR 22 1938	-15
	DEC 28 1938	8	APR 4 1939	-2
	JAN 2 1940	13	APR 16 1940	10
	JAN 5 1941	16	APR 11 1941	5
	JAN 3 1942	14	MAR 26 1942	-11
	DEC 7 1942	-13	APR 2 1943	-4
	DEC 16 1943	-4	APR 8 1944	2
	DEC 18 1944	-2	MAR 20 1945	-17
	DEC 13 1945	-7	MAR 21 1946	-16
	DEC 30 1946	10	APR 10 1947	4
	DEC 21 1947	1	APR 3 1948	-3
	DEC 24 1948	4	MAR 30 1949	-7
	DEC 23 1949	3	APR 11 1950	5
	DEC 11 1950	-9	APR 12 1951	6
	DEC 16 1951	-4	APR 8 1952	2
	DEC 30 1952	10	APR 21 1953	15
	DEC 30 1953	10	MAR 25 1954	-12
	JAN 2 1955	13	APR 4 1955	-2
	DEC 12 1955	-8	APR 4 1956	-2
	DEC 14 1956	-6	APR 4 1957	-2
	DEC 30 1957	10	APR 4 1958	-2
	DEC 9 1958	-11	APR 14 1959	8
	DEC 29 1959	9	************	
TOTAL	106		105	
EARLY	NOV 23		MAR 9	
LATE	JAN 30		MAY 6	
MEAN	DEC 20	11.36	APR 6	10.99

173. NAME OF LAKE: MONONA ID CODE: 140183
STATE/PROV: WIS
LAT: 43 4 N AREA: 13.50 (SQ KM) MAX DEPTH: 19.5
LONG: 89 22 W MEAN DEPTH: 8.4 (METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 106

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
DEC 13 1851	-1	MAR 25 1852	-9
DEC 21 1853	7	************	
DEC 18 1855	4	APR 14 1856	11
DEC 4 1856	-10	MAY 4 1857	31
NOV 23 1857	-21	MAR 22 1858	-12
DEC 11 1858	-3	MAR 15 1859	-19
DEC 6 1859	-8	MAR 26 1860	-8
DEC 2 1860	-12	APR 10 1861	7
DEC 1 1861	-13	APR 13 1862	10
DEC 7 1862	-7	APR 5 1863	2
DEC 11 1863	-3	APR 20 1864	17
DEC 9 1864	-5	APR 5 1865	2
DEC 14 1865	0	APR 18 1866	15
DEC 12 1866	-2	APR 19 1867	16
DEC 14 1867	0	APR 31 1868	28
DEC 10 1868	-4	APR 15 1869	12
NOV 24 1869	-20	APR 11 1870	8
DEC 22 1870	8	APR 1 1871	-2
NOV 30 1871	-14	APR 20 1872	17
NOV 28 1872	-16	APR 18 1873	15
NOV 29 1873	-15	APR 14 1874	11
DEC 12 1874	-2	APR 14 1875	11
JAN 10 1876	27	APR 10 1876	7
DEC 5 1876	-9	APR 16 1877	13
JAN 6 1878	23	MAR 9 1878	-25
DEC 15 1878	2	APR 10 1879	7
DEC 16 1879	2	MAR 18 1880	-16
NOV 22 1880	-22	MAY 1 1881	28
JAN 1 1882	18	MAR 19 1882	-15
DEC 7 1882	-7	APR 13 1883	10
DEC 17 1883	3	APR 15 1884	12

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
DEC 17 1884	3	APR 17 1885	14
DEC 7 1885	-7	APR 17 1886	14
DEC 5 1886	-9	APR 15 1887	12
NOV 28 1887	-16	APR 13 1888	10
DEC 29 1888	15	MAR 26 1889	-8
JAN 14 1890	31	MAR 29 1890	-5
DEC 24 1890	10	APR 16 1891	13
DEC 27 1891	13	APR 1 1892	-2
DEC 11 1892	-3	APR 7 1893	4
DEC 2 1893	-12	MAR 11 1894	-23
DEC 25 1894	11	APR 8 1895	5
DEC 4 1895	-10	APR 1 1896	-2
DEC 3 1897	-11	APR 5 1898	2
DEC 15 1897	1	MAR 26 1898	-8
DEC 7 1898	-7	APR 15 1899	12
DEC 25 1899	11	APR 16 1900	13
DEC 14 1900	0	APR 11 1901	8
DEC 24 1901	10	MAR 27 1902	-7
DEC 26 1902	12	MAR 21 1903	-13
NOV 27 1903	-17	APR 15 1904	12
DEC 13 1904	-1	APR 3 1905	0
DEC 14 1905	0	APR 8 1906	5
DEC 8 1906	-6	MAR 24 1907	-10
DEC 11 1907	-3	MAR 26 1908	-8
DEC 9 1908	-5	APR 6 1909	3
DEC 18 1909	4	MAR 24 1910	-10
DEC 8 1910	-6	MAR 21 1911	-13
DEC 18 1911	4	APR 9 1912	6
DEC 19 1912	5	APR 2 1913	-1
DEC 27 1913	13	APR 2 1914	-1
DEC 15 1914	1	APR 9 1915	6
DEC 15 1915	1	APR 4 1916	1
DEC 16 1916	2	APR 11 1917	8
DEC 8 1917	-6	APR 3 1918	0
DEC 27 1918	13	APR 20 1919	17
DEC 3 1919	-11	MAR 28 1920	-6
DEC 21 1920	7	MAR 16 1921	-18
DEC 19 1921	5	MAR 25 1922	-9
DEC 13 1922	-1	APR 19 1923	16
JAN 1 1924	18	APR 13 1924	10
DEC 14 1924	0	MAR 27 1925	-7
DEC 10 1925	-4	APR 15 1926	12
DEC 5 1926	-9	MAR 17 1927	-17
DEC 9 1927	-5	MAR 26 1928	-8
DEC 21 1928	7	MAR 27 1929	-7
DEC 3 1929	-11	MAR 17 1930	-17
DEC 16 1930	2	MAR 24 1931	-10
JAN 30 1932	47	MAR 30 1932	-4
DEC 10 1932	-4	MAR 27 1933	-7
DEC 13 1933	-1	MAR 26 1934	-8
DEC 20 1934	6	MAR 28 1935	-6
DEC 11 1935	-3	MAR 27 1936	-7
JAN 5 1937	22	APR 12 1937	9
DEC 1 1937	-13	MAR 22 1938	-12
DEC 19 1938	5	MAR 31 1939	-3
DEC 31 1939	17	APR 11 1940	8
DEC 3 1940	-11	APR 9 1941	6
DEC 29 1941	15	MAR 24 1942	-10
DEC 7 1942	-7	MAR 31 1943	-3
DEC 14 1943	0	MAR 24 1944	-10
DEC 18 1944	4	MAR 17 1945	-17
DEC 12 1945	-2	MAR 21 1946	-13
DEC 18 1946	4	APR 5 1947	2
DEC 9 1947	-5	MAR 26 1948	-8
DEC 24 1948	10	MAR 26 1949	-8
DEC 15 1949	1	APR 7 1950	4
DEC 11 1950	-3	APR 8 1951	5
DEC 16 1951	2	APR 6 1952	3
DEC 17 1952	3	MAR 20 1953	-14
DEC 30 1953	16	MAR 12 1954	-22
DEC 31 1954	17	MAR 24 1955	-10
DEC 6 1955	-8	MAR 24 1956	-10
DEC 13 1956	-1	MAR 15 1957	-19
DEC 12 1957	-2	MAR 31 1958	-3
DEC 8 1958	-6	***********	

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
TOTAL	106		104	
EARLY	NOV 22		MAR 9	
LATE	JAN 30		MAY 4	
MEAN	DEC 14	11.21	APR 3	11.77

174. NAME OF LAKE: NAGAWICKA ID CODE: 140193
STATE/PROV: WIS
LAT: 43 5 N AREA: 3.71 MAX DEPTH: 28.8
LONG: 88 23 W (SQ KM) MEAN DEPTH: 11.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 12

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 17 1947	14
	************		MAR 25 1948	-9
	************		MAR 28 1949	-6
	************		APR 1 1950	-2
	************		APR 7 1951	4
	************		APR 3 1952	0
	************		MAR 31 1953	-3
	************		APR 5 1954	2
	************		APR 6 1955	3
	************		MAR 30 1956	-4
	************		APR 2 1957	-1
	************		APR 5 1958	2
TOTAL	0		12	
EARLY	******		MAR 25	
LATE	******		APR 17	
MEAN	******	0.0	APR 3	5.60

175. NAME OF LAKE: ROCK ID CODE: 140213
STATE/PROV: WIS
LAT: 43 5 N AREA: 5.55 MAX DEPTH: 17.1
LONG: 88 54 W (SQ KM) MEAN DEPTH: 6.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 32

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 14 1924	13
	************		MAR 27 1925	-5
	************		APR 16 1926	15
	************		MAR 19 1927	-13
	************		MAR 24 1928	-8
	************		MAR 28 1929	-4
	************		MAR 18 1930	-14
	************		MAR 25 1931	-7
	************		APR 4 1932	3
	************		MAR 19 1933	-13
	************		MAR 21 1934	-11
	************		MAR 30 1935	-2
	************		MAR 29 1936	-3
	************		APR 12 1937	11
	************		MAR 22 1938	-10
	************		APR 4 1939	3
	************		APR 15 1940	14
	************		APR 11 1941	10
	************		APR 1 1942	0
	************		APR 4 1943	3
	************		APR 4 1944	3
	************		MAR 24 1945	-8
	************		MAR 22 1946	-10
	************		APR 12 1947	11
	************		MAR 31 1948	-1
	************		MAR 29 1949	-3
	************		APR 11 1950	10

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 14 1951	-13
	************		APR 9 1952	8
	************		MAR 21 1953	-11
	************		MAR 24 1954	-8
	************		APR 5 1955	4
TOTAL	0		32	
EARLY	******		MAR 18	
LATE	******		APR 16	
MEAN	******	0.0	APR 1	9.01

176. NAME OF LAKE: SHELL
STATE/PROV: WIS

ID CODE: 140233

LAT: 45 44 N
LONG: 91 54 W

AREA: 10.47 (SQ KM)

MAX DEPTH: 11.0
MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY

NUMBER OF ENTRIES: 58

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		APR 22 1892	0
************		MAY 10 1893	18
************		APR 19 1894	-3
************		APR 19 1895	-3
NOV 30 1905	0	APR 20 1905	-2
DEC 3 1906	3	MAY 5 1907	13
DEC 1 1907	1	APR 17 1908	-5
DEC 5 1908	5	MAY 11 1909	19
DEC 7 1909	7	APR 27 1910	5
NOV 28 1910	-2	APR 28 1911	6
NOV 16 1911	-14	APR 15 1912	-7
DEC 8 1912	8	APR 23 1913	1
DEC 18 1913	18	APR 25 1914	3
DEC 18 1914	18	APR 21 1915	-1
DEC 2 1915	2	APR 21 1916	-1
NOV 25 1916	-5	MAY 3 1917	11
DEC 4 1917	4	APR 22 1918	0
DEC 6 1918	6	APR 14 1919	-8
NOV 26 1919	-4	APR 25 1920	3
DEC 17 1920	17	APR 6 1921	-16
DEC 6 1921	6	APR 28 1922	6
DEC 6 1922	6	MAY 2 1923	10
DEC 5 1923	5	APR 26 1924	4
NOV 29 1924	-1	APR 27 1925	5
NOV 24 1925	-6	APR 24 1926	2
NOV 21 1926	-9	APR 14 1927	-8
DEC 1 1927	1	MAY 1 1928	9
DEC 5 1928	5	APR 7 1929	-15
NOV 24 1929	-6	APR 12 1930	-10
NOV 28 1930	-2	APR 11 1931	-11
DEC 1 1931	1	APR 22 1932	0
NOV 16 1932	-14	APR 23 1933	1
NOV 15 1933	-15	APR 25 1934	3
DEC 2 1934	2	APR 22 1935	0
NOV 22 1935	-8	MAY 1 1936	9
NOV 25 1936	-5	APR 26 1937	4
NOV 22 1937	-8	APR 11 1938	-11
NOV 23 1938	-7	APR 25 1939	3
DEC 14 1939	14	APR 30 1940	8
NOV 28 1940	-2	APR 14 1941	-8
DEC 10 1941	10	APR 17 1942	-5
NOV 28 1942	-2	APR 24 1943	2
NOV 20 1943	-10	APR 25 1944	3
DEC 12 1944	12	MAR 31 1945	-22
NOV 25 1935	-5	APR 3 1946	-19
NOV 25 1946	-5	APR 29 1947	7
NOV 26 1947	-4	APR 18 1948	-4
DEC 7 1948	7	APR 17 1949	-5
DEC 2 1949	2	MAY 9 1950	17
NOV. 24 1950	-6	MAY 1 1951	9
NOV 18 1951	-12	APR 26 1952	4
NOV 19 1952	-11	APR 16 1953	-6

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	DEC 10 1953	10	APR 20 1954	-2
	DEC 2 1954	2	APR 17 1955	-5
	NOV 19 1955	-11	APR 28 1956	6
	DEC 8 1956	8	APR 24 1957	2
	DEC 2 1957	2	APR 16 1958	-6
	NOV 28 1958	-2	APR 22 1959	0
TOTAL	54		58	
EARLY	NOV 15		MAR 31	
LATE	DEC 18		MAY 11	
MEAN	NOV 30	8.11	APR 22	8.42

177. NAME OF LAKE: SPOONER ID CODE: 140243
STATE/PROV: WIS
LAT: 45 50 N AREA: 4.42 MAX DEPTH: 5.2
LONG: 91 49 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 4

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 11 1956	-5
	************		APR 22 1957	6
	************		APR 12 1958	-4
	NOV 27 1958	0	APR 17 1959	1
TOTAL	1		4	
EARLY	NOV 27		APR 11	
LATE	NOV 27		APR 22	
MEAN	NOV 27	0.0	APR 16	4.42

178. NAME OF LAKE: SUMMIT ID CODE: 140253
STATE/PROV: WIS
LAT: 46 28 N AREA: 1.55 MAX DEPTH: 4.9
LONG: 92 15 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 21 1958	-1
	NOV 17 1958	0	APR 23 1959	1
TOTAL	1		2	
EARLY	NOV 17		APR 21	
LATE	NOV 17		APR 23	
MEAN	NOV 17	0.0	APR 22	1.00

179. NAME OF LAKE: TROUT ID CODE: 140263
STATE/PROV: WIS
LAT: 46 3 N AREA: 15.46 MAX DEPTH: 35.0
LONG: 89 40 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 10

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
************		APR 30 1942	0
************		MAY 1 1943	1
************		MAY 3 1944	3
************		MAY 6 1947	6
************		APR 23 1948	-7
************		MAY 15 1950	15
************		APR 27 1952	-3
************		APR 23 1953	-7
************		APR 22 1954	-8

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 29 1959	-1
TOTAL	0		10	
EARLY	******		APR 22	
LATE	******		MAY 15	
MEAN	******	0.0	APR 30	6.66

180. NAME OF LAKE: WAUBESA ID CODE: 140273
STATE/PROV: WIS
LAT: 43 1 N AREA: 8.55 MAX DEPTH: 10.4
LONG: 89 19 W (SQ KM) MEAN DEPTH: 4.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 17

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAR 27 1939	-5
	************		APR 10 1940	9
	************		APR 9 1941	8
	************		APR 24 1942	23
	************		APR 2 1943	1
	************		MAR 30 1944	-2
	************		MAR 17 1945	-15
	************		MAR 19 1946	-13
	************		APR 6 1947	5
	************		MAR 27 1948	-5
	************		MAR 27 1949	-5
	DEC 14 1949	5	APR 7 1950	6
	NOV 23 1950	-16	APR 11 1951	10
	DEC 14 1951	5	APR 5 1952	4
	DEC 6 1952	-3	MAR 21 1953	-11
	DEC 18 1953	9	MAR 18 1954	-14
	DEC 10 1954	1	APR 3 1955	2
TOTAL	6		17	
EARLY	NOV 23		MAR 17	
LATE	DEC 18		APR 24	
MEAN	DEC 9	8.13	APR 1	9.84

181. NAME OF LAKE: WINGRA ID CODE: 140305
STATE/PROV: WIS
LAT: 43 3 N AREA: 0.0 MAX DEPTH: 4.2
LONG: 89 25 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 44

FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
DEC 29 1877	34	MAR 9 1878	-20
DEC 6 1878	11	MAR 29 1879	0
NOV 19 1879	-6	MAR 23 1880	-6
NOV 16 1880	-9	APR 29 1881	31
NOV 20 1881	-5	MAR 2 1882	-27
DEC 2 1882	7	APR 10 1883	12
NOV 15 1883	-10	APR 13 1884	15
NOV 24 1884	-1	APR 13 1885	15
DEC 5 1885	10	APR 15 1886	17
NOV 24 1886	-1	************	
NOV 20 1887	-5	APR 13 1888	15
DEC 12 1888	17	MAR 24 1889	-5
************		MAR 24 1890	-5
DEC 4 1890	9	************	
************		APR 2 1892	4
NOV 18 1892	-7	APR 5 1893	7
NOV 17 1893	-8	MAR 10 1894	-19
NOV 15 1894	-10	************	
************		MAR 30 1896	1
NOV 2 1913	-23	************	
NOV 29 1914	4	************	

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	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		MAR 20 1916	-9
	NOV 27 1916	2	************	
	NOV 20 1926	-5	************	
	************		MAR 24 1928	-5
	NOV 29 1928	4	MAR 25 1929	-4
	NOV 17 1929	-8	************	
	************		MAR 25 1935	-4
	************		MAR 24 1936	-5
	************		APR 10 1937	-12
	************		MAR 21 1938	-8
	NOV 25 1938	0	MAR 25 1939	-4
	************		APR 9 1940	11
	NOV 13 1940	-12	************	
	************		MAR 24 1944	-5
	DEC 2 1944	7	MAR 17 1945	-12
	NOV 24 1945	-1	MAR 20 1946	-9
	************		MAR 26 1948	-3
	DEC 7 1948	12	MAR 27 1949	-2
	NOV 25 1949	0	APR 7 1950	9
	NOV 23 1950	-2	APR 9 1951	11
	NOV 28 1952	3	************	
	NOV 27 1958	2	************	
	NOV 15 1959	-10	************	
TOTAL	32		32	
EARLY	NOV 2		MAR 2	
LATE	DEC 29		APR 29	
MEAN	NOV 25	10.29	MAR 29	12.10

182. NAME OF LAKE: WINNEBAGO   ID CODE: 140313
STATE/PROV: WIS
LAT: 44 0 N   AREA: 557.52   MAX DEPTH: 6.4
LONG: 88 24 W   (SQ KM)   MEAN DEPTH: 4.7
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 3

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 2 1957	-6
	DEC 7 1957	4	APR 5 1958	-3
	NOV 29 1958	-4	APR 17 1959	9
TOTAL	2		3	
EARLY	NOV 29		APR 2	
LATE	DEC 7		APR 17	
MEAN	DEC 3	4.00	APR 8	6.48

183. NAME OF LAKE: BONE   ID CODE: 140353
STATE/PROV: WIS
LAT: 45 32 N   AREA: 7.21   MAX DEPTH: 13.1
LONG: 92 23 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 23 1955	0	************	
TOTAL	1		0	
EARLY	NOV 23		******	
LATE	NOV 23		******	
MEAN	NOV 23	0.0	******	0.0

184. NAME OF LAKE: BROWNS ID CODE: 140373
STATE/PROV: WIS
LAT: 42 41 N AREA: 1.60 MAX DEPTH: 13.4
LONG: 88 15 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 2

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 1 1955	0
	NOV 22 1955	0	************	
TOTAL	1		1	
EARLY	NOV 22		APR 1	
LATE	NOV 22		APR 1	
MEAN	NOV 22	0.0	APR 1	0.0

185. NAME OF LAKE: MUD ID CODE: 140423
STATE/PROV: WIS
LAT: 42 42 N AREA: 0.16 MAX DEPTH: 8.3
LONG: 88 8 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 7 1955	0	************	
TOTAL	1		0	
EARLY	NOV 7		******	
LATE	NOV 7		******	
MEAN	NOV 7	0.0	******	0.0

186. NAME OF LAKE: TURTLE ID CODE: 140453
STATE/PROV: WIS
LAT: 46 14 N AREA: 5.80 MAX DEPTH: 14.5
LONG: 89 19 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	NOV 28 1955	0	************	
TOTAL	1		0	
EARLY	NOV 28		******	
LATE	NOV 28		******	
MEAN	NOV 28	0.0	******	0.0

187. NAME OF LAKE: PEWAUKEE ID CODE: 140473
STATE/PROV: WIS
LAT: 43 5 N AREA: 10.10 MAX DEPTH: 13.7
LONG: 88 17 W (SQ KM) MEAN DEPTH: 3.9
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 1

	FREEZE DATE	DEVIATION	THAW DATE	DEVIATION
	************		APR 1 1955	0
TOTAL	0		1	
EARLY	******		APR 1	
LATE	******		APR 1	
MEAN	******	0.0	APR 1	0.0

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188. NAME OF LAKE: PINE — ID CODE: 140481
STATE/PROV: WIS
LAT: 43 7 N — AREA: 2.85 (SQ KM) — MAX DEPTH: 26.0
LONG: 88 23 W — MEAN DEPTH: 12.1 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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189. NAME OF LAKE: NORTH(EAST) — ID CODE: 140491
STATE/PROV: WIS
LAT: 43 9 N — AREA: 1.77 (SQ KM) — MAX DEPTH: 23.7
LONG: 88 23 W — MEAN DEPTH: 12.7 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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190. NAME OF LAKE: NORTH(WEST) — ID CODE: 140501
STATE/PROV: WIS
LAT: 43 9 N — AREA: 0.47 (SQ KM) — MAX DEPTH: 22.4
LONG: 88 23 W — MEAN DEPTH: 11.4 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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191. NAME OF LAKE: OKAUCHEE — ID CODE: 140511
STATE/PROV: WIS
LAT: 43 8 N — AREA: 4.61 (SQ KM) — MAX DEPTH: 28.6
LONG: 88 26 W — MEAN DEPTH: 12.1 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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192. NAME OF LAKE: OCONOMOWOC(MAIN) — ID CODE: 140521
STATE/PROV: WIS
LAT: 43 6 N — AREA: 3.10 (SQ KM) — MAX DEPTH: 18.9
LONG: 88 28 W — MEAN DEPTH: 9.5 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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193. NAME OF LAKE: FOWLER — ID CODE: 140531
STATE/PROV: WIS
LAT: 43 7 N — AREA: 0.34 (SQ KM) — MAX DEPTH: 15.2
LONG: 88 30 W — MEAN DEPTH: 4.4 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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194. NAME OF LAKE: LAC LA BELLE — ID CODE: 140541
STATE/PROV: WIS
LAT: 43 8 N — AREA: 4.53 (SQ KM) — MAX DEPTH: 14.2
LONG: 88 31 W — MEAN DEPTH: 3.3 (METERS)

FREEZE/THAW HISTORY — NUMBER OF ENTRIES: 0

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195. NAME OF LAKE: SILVER ID CODE: 140551
STATE/PROV: WIS
LAT: 43 5 N AREA: 0.90 MAX DEPTH: 13.4
LONG: 88 30 W (SQ KM) MEAN DEPTH: 4.8
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

196. NAME OF LAKE: DELAVAN ID CODE: 140561
STATE/PROV: WIS
LAT: 42 37 N AREA: 8.39 MAX DEPTH: 17.2
LONG: 88 36 W (SQ KM) MEAN DEPTH: 8.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

197. NAME OF LAKE: GREEN ID CODE: 140571
STATE/PROV: WIS
LAT: 43 49 N AREA: 29.72 MAX DEPTH: 72.2
LONG: 89 0 W (SQ KM) MEAN DEPTH: 33.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

198. NAME OF LAKE: BEULAH(4BASINS) ID CODE: 140581
STATE/PROV: WIS
LAT: 42 49 N AREA: 3.39 MAX DEPTH: 17.7
LONG: 88 23 W (SQ KM) MEAN DEPTH: 8.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

199. NAME OF LAKE: BIG CEDAR ID CODE: 140591
STATE/PROV: WIS
LAT: 43 23 N AREA: 3.87 MAX DEPTH: 31.9
LONG: 88 16 W (SQ KM) MEAN DEPTH: 11.1
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

200. NAME OF LAKE: BUTTERNUT ID CODE: 140611
STATE/PROV: WIS
LAT: 45 58 N AREA: 4.07 MAX DEPTH: 9.8
LONG: 90 31 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

201. NAME OF LAKE: BEAR ID CODE: 140521
STATE/PROV: WIS
LAT: 45 38 N AREA: 5.50 MAX DEPTH: 26.5
LONG: 91 49 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

202. NAME OF LAKE: PRAIRIE ID CODE: 140531
STATE/PROV: WIS
LAT: 45 22 N AREA: 6.21 MAX DEPTH: 4.9
LONG: 91 41 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

203. NAME OF LAKE: RED CEDAR ID CODE: 140641
STATE/PROV: WIS
LAT: 45 36 N AREA: 7.46 MAX DEPTH: 15.2
LONG: 91 35 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

204. NAME OF LAKE: LOWER EAU CLAIRE ID CODE: 140651
STATE/PROV: WIS
LAT: 46 16 N AREA: 3.31 MAX DEPTH: 12.8
LONG: 91 33 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

205. NAME OF LAKE: MIDDLE EAU CLAIR ID CODE: 140651
STATE/PROV: WIS
LAT: 46 18 N AREA: 3.65 MAX DEPTH: 19.8
LONG: 91 31 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

206. NAME OF LAKE: NAMEKAGON ID CODE: 140671
STATE/PROV: WIS
LAT: 46 12 N AREA: 13.00 MAX DEPTH: 14.0
LONG: 91 7 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

207. NAME OF LAKE: UPPER EAU CLAIRE ID CODE: 140691
STATE/PROV: WIS
LAT: 46 19 N AREA: 4.17 MAX DEPTH: 25.6
LONG: 91 29 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

208. NAME OF LAKE: BIG SAND ID CODE: 140711
STATE/PROV: WIS
LAT: 45 50 N AREA: 5.67 MAX DEPTH: 16.8
LONG: 92 13 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

209. NAME OF LAKE: CLAM ID CODE: 140721
STATE/PROV: WIS
LAT: 45 48 N AREA: 4.88 MAX DEPTH: 3.4
LONG: 92 20 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

210. NAME OF LAKE: YELLOW ID CODE: 140731
STATE/PROV: WIS
LAT: 45 55 N AREA: 9.26 MAX DEPTH: 9.8
LONG: 92 24 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

211. NAME OF LAKE: LONG ID CODE: 140751
STATE/PROV: WIS
LAT: 45 15 N AREA: 4.30 MAX DEPTH: 29.2
LONG: 91 24 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

212. NAME OF LAKE: WISSOTA ID CODE: 140761
STATE/PROV: WIS
LAT: 44 57 N AREA: 25.50 MAX DEPTH: 22.0
LONG: 91 20 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

213. NAME OF LAKE: ARBUTUS ID CODE: 140771
STATE/PROV: WIS
LAT: 44 26 N AREA: 3.32 MAX DEPTH: 17.1
LONG: 90 42 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

214. NAME OF LAKE: FOX ID CODE: 140801
STATE/PROV: WIS
LAT: 43 35 N AREA: 10.63 MAX DEPTH: 5.8
LONG: 88 56 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

215. NAME OF LAKE: BARDON ID CODE: 140821
STATE/PROV: WIS
LAT: 46 13 N AREA: 3.36 MAX DEPTH: 31.1
LONG: 91 53 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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216. NAME OF LAKE: NEBAGAMON ID CODE: 140341
STATE/PROV: WIS
LAT: 46 30 N AREA: 3.70 MAX DEPTH: 17.1
LONG: 91 43 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

217. NAME OF LAKE: ST CROIX FLOWAGE ID CODE: 140851
STATE/PROV: WIS
LAT: 46 15 N AREA: 7.75 MAX DEPTH: 8.5
LONG: 91 52 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

218. NAME OF LAKE: ALTOONA ID CODE: 140881
STATE/PROV: WIS
LAT: 44 49 N AREA: 3.40 MAX DEPTH: 7.6
LONG: 91 26 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

219. NAME OF LAKE: EAU CLAIRE ID CODE: 140891
STATE/PROV: WIS
LAT: 44 46 N AREA: 4.03 MAX DEPTH: 7.6
LONG: 91 6 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

220. NAME OF LAKE: BUTTERNUT ID CODE: 140901
STATE/PROV: WIS
LAT: 45 55 N AREA: 5.24 MAX DEPTH: 12.8
LONG: 89 0 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

221. NAME OF LAKE: FRANKLIN ID CODE: 140911
STATE/PROV: WIS
LAT: 45 56 N AREA: 3.61 MAX DEPTH: 16.2
LONG: 89 0 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

222. NAME OF LAKE: KENTUCK ID CODE: 140921
STATE/PROV: WIS
LAT: 45 59 N AREA: 4.03 MAX DEPTH: 12.2
LONG: 89 0 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

223. NAME OF LAKE: PINE ID CODE: 140941
STATE/PROV: WIS
LAT: 45 41 N AREA: 6.76 MAX DEPTH: 4.3
LONG: 88 59 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

224. NAME OF LAKE: KOSHKONONG ID CODE: 140951
STATE/PROV: WIS
LAT: 42 52 N AREA: 42.35 MAX DEPTH: 2.1
LONG: 88 58 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

225. NAME OF LAKE: CALDRON FALLS RE ID CODE: 140961
STATE/PROV: WIS
LAT: 45 21 N AREA: 4.12 MAX DEPTH: 12.2
LONG: 88 15 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

226. NAME OF LAKE: HIGH FALLS RESER ID CODE: 140971
STATE/PROV: WIS
LAT: 45 19 N AREA: 6.07 MAX DEPTH: 16.5
LONG: 88 11 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

227. NAME OF LAKE: CLEAR ID CODE: 140991
STATE/PROV: WIS
LAT: 45 52 N AREA: 4.25 MAX DEPTH: 30.5
LONG: 89 38 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

228. NAME OF LAKE: PELICAN ID CODE: 141001
STATE/PROV: WIS
LAT: 45 30 N AREA: 14.52 MAX DEPTH: 11.9
LONG: 89 12 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

229. NAME OF LAKE: SQUIRREL ID CODE: 141021
STATE/PROV: WIS
LAT: 45 52 N AREA: 5.48 MAX DEPTH: 13.7
LONG: 89 54 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

230. NAME OF LAKE: TOMAHAWK ID CODE: 141031
STATE/PROV: WIS
LAT: 45 50 N AREA: 14.70 MAX DEPTH: 24.0
LONG: 89 40 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

231. NAME OF LAKE: THUNDER ID CODE: 141041
STATE/PROV: WIS
LAT: 45 47 N AREA: 7.16 MAX DEPTH: 2.7
LONG: 89 13 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

232. NAME OF LAKE: BALSAM ID CODE: 141051
STATE/PROV: WIS
LAT: 45 28 N AREA: 8.31 MAX DEPTH: 11.3
LONG: 92 26 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

233. NAME OF LAKE: BIG ROUND ID CODE: 141061
STATE/PROV: WIS
LAT: 45 32 N AREA: 4.11 MAX DEPTH: 5.2
LONG: 92 19 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

234. NAME OF LAKE: CEDAR ID CODE: 141071
STATE/PROV: WIS
LAT: 45 13 N AREA: 4.45 MAX DEPTH: 9.8
LONG: 92 35 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

235. NAME OF LAKE: WAPOGASSET ID CODE: 141081
STATE/PROV: WIS
LAT: 45 20 N AREA: 4.80 MAX DEPTH: 9.8
LONG: 92 26 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

236. NAME OF LAKE: PIKE ID CODE: 141091
STATE/PROV: WIS
LAT: 45 54 N AREA: 2.99 MAX DEPTH: 7.6
LONG: 90 4 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

C3

237. NAME OF LAKE: ISLAND ID CODE: 141121
STATE/PROV: WIS
LAT: 45 19 N AREA: 2.14 MAX DEPTH: 16.5
LONG: 91 23 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

238. NAME OF LAKE: REDSTONE ID CODE: 141131
STATE/PROV: WIS
LAT: 43 37 N AREA: 2.43 MAX DEPTH: 12.2
LONG: 90 6 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

239. NAME OF LAKE: GRINDSTONE ID CODE: 141141
STATE/PROV: WIS
LAT: 45 56 N AREA: 12.60 MAX DEPTH: 18.0
LONG: 91 25 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

240. NAME OF LAKE: LAC COURT OREILL ID CODE: 141151
STATE/PROV: WIS
LAT: 45 54 N AREA: 20.40 MAX DEPTH: 27.4
LONG: 91 26 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

241. NAME OF LAKE: CHETEC ID CODE: 141161
STATE/PROV: WIS
LAT: 45 42 N AREA: 7.78 MAX DEPTH: 8.5
LONG: 91 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

242. NAME OF LAKE: CHIPPEWA ID CODE: 141171
STATE/PROV: WIS
LAT: 43 56 N AREA: 62.00 MAX DEPTH: 25.0
LONG: 91 10 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

243. NAME OF LAKE: LOST LAND ID CODE: 141181
STATE/PROV: WIS
LAT: 46 6 N AREA: 5.29 MAX DEPTH: 6.4
LONG: 91 9 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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244. NAME OF LAKE: MOOSE ID CODE: 141191
STATE/PROV: WIS
LAT: 46 1 N AREA: 6.76 MAX DEPTH: 6.4
LONG: 91 2 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

245. NAME OF LAKE: NELSON ID CODE: 141201
STATE/PROV: WIS
LAT: 46 5 N AREA: 10.15 MAX DEPTH: 10.1
LONG: 91 23 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

246. NAME OF LAKE: ROUND ID CODE: 141211
STATE/PROV: WIS
LAT: 46 1 N AREA: 11.30 MAX DEPTH: 21.4
LONG: 91 19 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

247. NAME OF LAKE: SPIDER ID CODE: 141221
STATE/PROV: WIS
LAT: 46 6 N AREA: 5.89 MAX DEPTH: 19.5
LONG: 91 14 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

248. NAME OF LAKE: TEAL ID CODE: 141231
STATE/PROV: WIS
LAT: 46 5 N AREA: 4.25 MAX DEPTH: 9.5
LONG: 91 7 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

249. NAME OF LAKE: SHAWANO ID CODE: 141241
STATE/PROV: WIS
LAT: 44 48 N AREA: 25.00 MAX DEPTH: 12.8
LONG: 88 32 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

250. NAME OF LAKE: BIG ST GERMAIN ID CODE: 141251
STATE/PROV: WIS
LAT: 45 56 N AREA: 5.93 MAX DEPTH: 10.7
LONG: 89 31 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

251. NAME OF LAKE: BIG MUSKELLUNGE   ID CODE: 141251
STATE/PROV: WIS
LAT: 46 1 N   AREA: 3.74   MAX DEPTH: 19.8
LONG: 89 37 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

252. NAME OF LAKE: BIG SAND   ID CODE: 141271
STATE/PROV: WIS
LAT: 46 4 N   AREA: 5.70   MAX DEPTH: 10.7
LONG: 88 59 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

253. NAME OF LAKE: CRAWLING STONE   ID CODE: 141291
STATE/PROV: WIS
LAT: 46 56 N   AREA: 5.94   MAX DEPTH: 24.4
LONG: 89 53 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

254. NAME OF LAKE: FENCE   ID CODE: 141301
STATE/PROV: WIS
LAT: 45 57 N   AREA: 13.52   MAX DEPTH: 26.3
LONG: 89 51 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

255. NAME OF LAKE: IKE WALTON   ID CODE: 141321
STATE/PROV: WIS
LAT: 46 2 N   AREA: 5.77   MAX DEPTH: 19.2
LONG: 89 48 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

256. NAME OF LAKE: LAC VIEUX DESERT   ID CODE: 141331
STATE/PROV: WIS
LAT: 46 8 N   AREA: 17.40   MAX DEPTH: 11.6
LONG: 89 7 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

257. NAME OF LAKE: PRESQUE ISLE   ID CODE: 141351
STATE/PROV: WIS
LAT: 46 13 N   AREA: 5.18   MAX DEPTH: 24.4
LONG: 89 47 W   (SQ KM)   MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY   NUMBER OF ENTRIES: 0

258. NAME OF LAKE: COMO ID CODE: 141371
STATE/PROV: WIS
LAT: 42 36 N AREA: 3.83 MAX DEPTH: 2.4
LONG: 88 30 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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259. NAME OF LAKE: NANCY ID CODE: 141401
STATE/PROV: WIS
LAT: 46 6 N AREA: 3.12 MAX DEPTH: 11.9
LONG: 92 0 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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260. NAME OF LAKE: PARTRIDGE ID CODE: 141421
STATE/PROV: WIS
LAT: 44 17 N AREA: 4.01 MAX DEPTH: 1.8
LONG: 88 53 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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261. NAME OF LAKE: WHITE ID CODE: 141431
STATE/PROV: WIS
LAT: 44 22 N AREA: 4.60 MAX DEPTH: 3.4
LONG: 88 56 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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262. NAME OF LAKE: SINNISSIPPI ID CODE: 141441
STATE/PROV: WIS
LAT: 43 22 N AREA: 11.58 MAX DEPTH: 2.4
LONG: 88 37 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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263. NAME OF LAKE: PUCKAWAY ID CODE: 141451
STATE/PROV: WIS
LAT: 43 45 N AREA: 22.00 MAX DEPTH: 1.5
LONG: 89 12 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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264. NAME OF LAKE: POYGAN ID CODE: 141461
STATE/PROV: WIS
LAT: 44 9 N AREA: 44.50 MAX DEPTH: 3.4
LONG: 88 50 W (SQ KM) MEAN DEPTH: 0.0
(METERS)

FREEZE/THAW HISTORY NUMBER OF ENTRIES: 0

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265.  NAME OF LAKE: RUSH                                ID CODE:  141471
      STATE/PROV:    WIS
      LAT:    43 56 N      AREA:    12.43    MAX DEPTH:     1.5
      LONG:   88 48 W              (SQ KM)   MEAN DEPTH:    0.0
                                                          (METERS)

      FREEZE/THAW HISTORY                 NUMBER OF ENTRIES:    0

      ------------------------------------------------------------

266.  NAME OF LAKE: POTATO                              ID CODE:  141481
      STATE/PROV:    WIS
      LAT:    45 19 N      AREA:     2.16    MAX DEPTH:    12.2
      LONG:   91 26 W              (SQ KM)   MEAN DEPTH:    0.0
                                                          (METERS)

      FREEZE/THAW HISTORY                 NUMBER OF ENTRIES:    0

      ------------------------------------------------------------

267.  NAME OF LAKE: METONGA                             ID CODE:  141491
      STATE/PROV:    WIS
      LAT:    45 32 N      AREA:     8.73    MAX DEPTH:    22.6
      LONG:   88 55 W              (SQ KM)   MEAN DEPTH:    0.0
                                                          (METERS)

      FREEZE/THAW HISTORY                 NUMBER OF ENTRIES:    0

      ------------------------------------------------------------

268.  NAME OF LAKE: WILLOW RESERVOIR                    ID CODE:  141501
      STATE/PROV:    WIS
      LAT:    45 43 N      AREA:    20.80    MAX DEPTH:     6.7
      LONG:   89 54 W              (SQ KM)   MEAN DEPTH:    0.0
                                                          (METERS)

      FREEZE/THAW HISTORY                 NUMBER OF ENTRIES:    0

      ------------------------------------------------------------

269.  NAME OF LAKE: NORTH TWIN                          ID CODE:  141511
      STATE/PROV:    WIS
      LAT:    46  3 N      AREA:    11.27    MAX DEPTH:    13.7
      LONG:   89  8 W              (SQ KM)   MEAN DEPTH:    0.0
                                                          (METERS)

      FREEZE/THAW HISTORY                 NUMBER OF ENTRIES:    0

      ------------------------------------------------------------

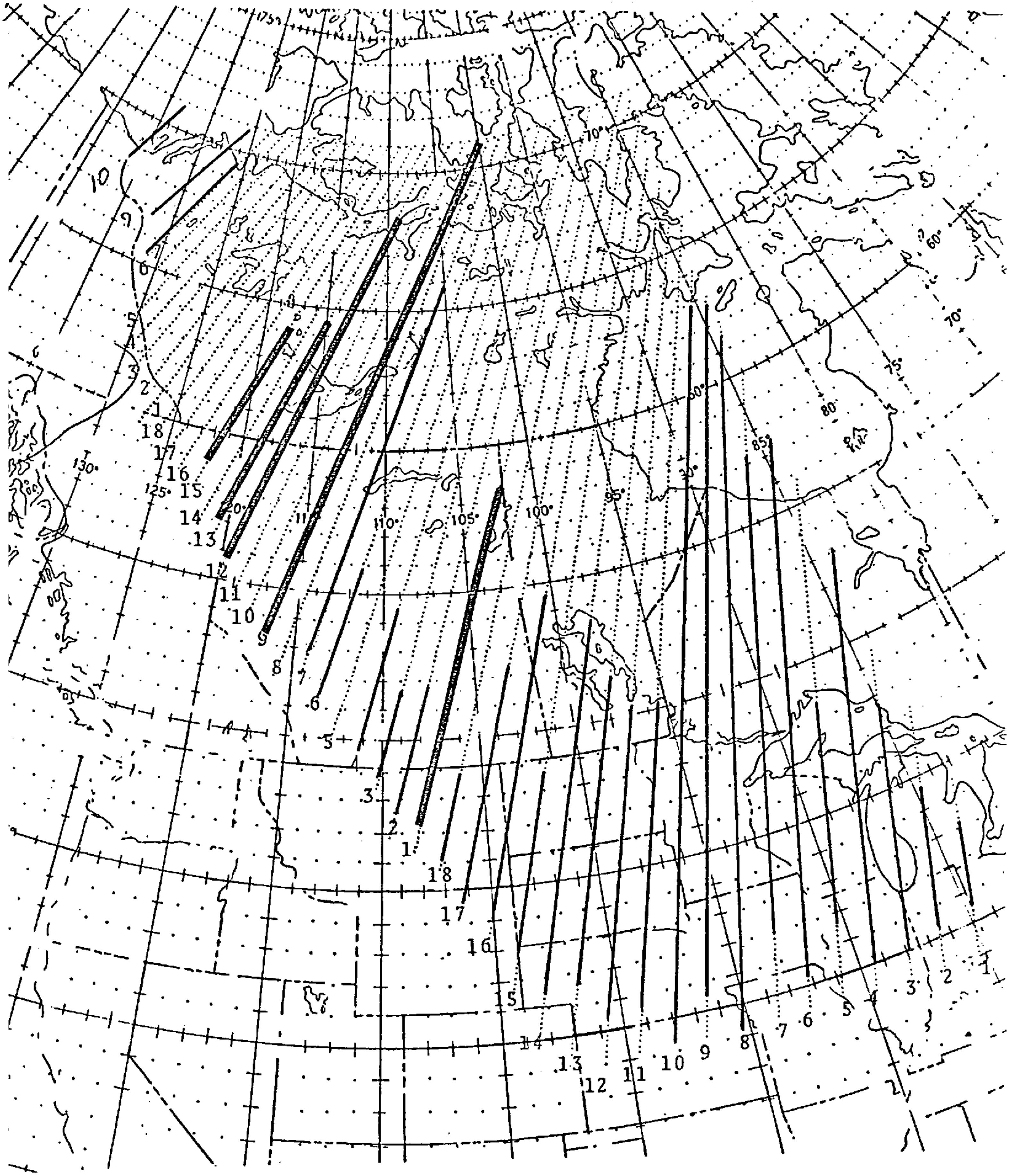
      *** END STATISTICAL ANALYSIS ***
```

APPENDIX C

ERTS-1 SWATH COVERAGE

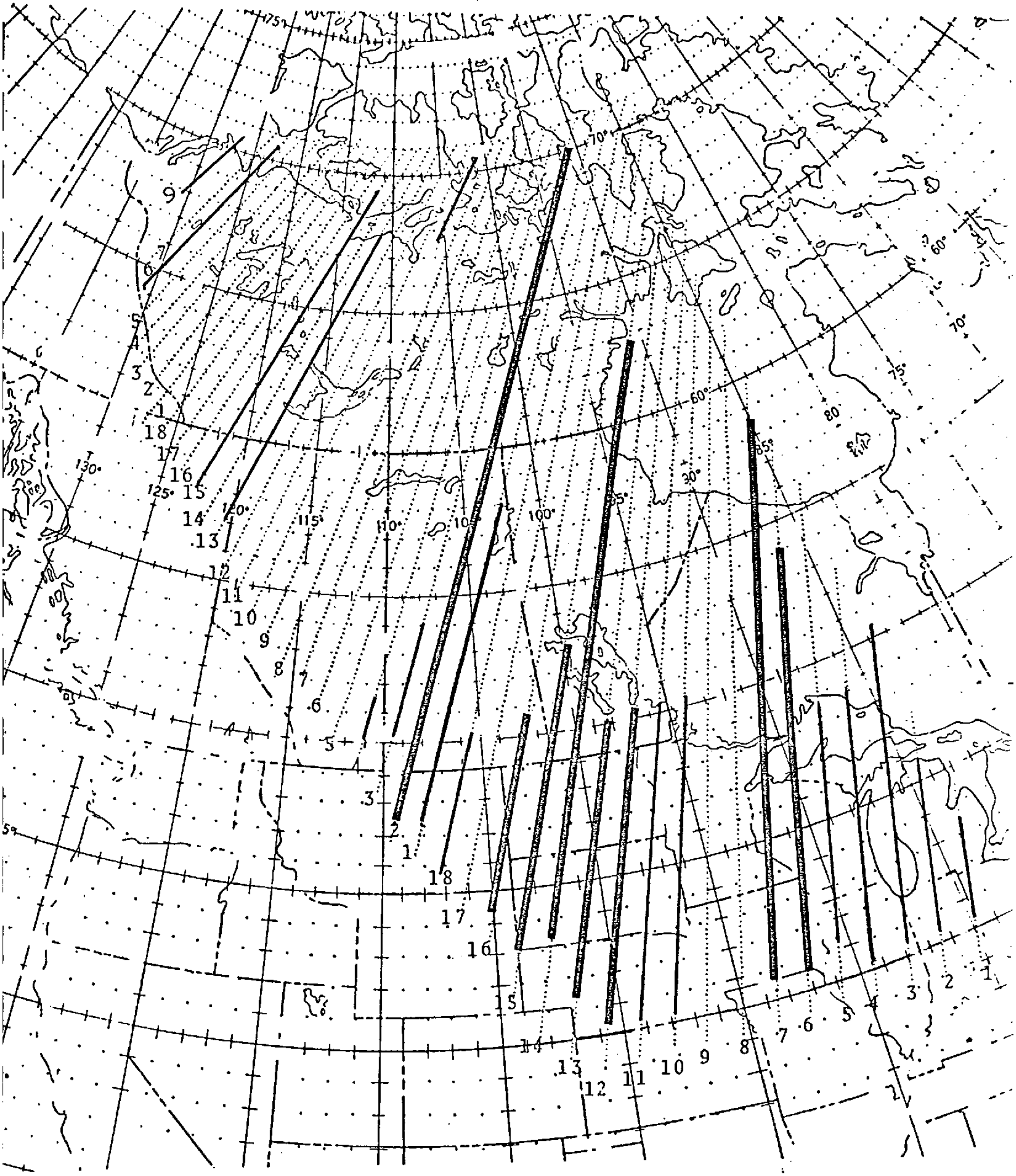
FOR THE 1972 ICE YEAR*

* Solid lines represent imagery received for analysis; heavy solid lines represent swaths in which the transition zone was observed.



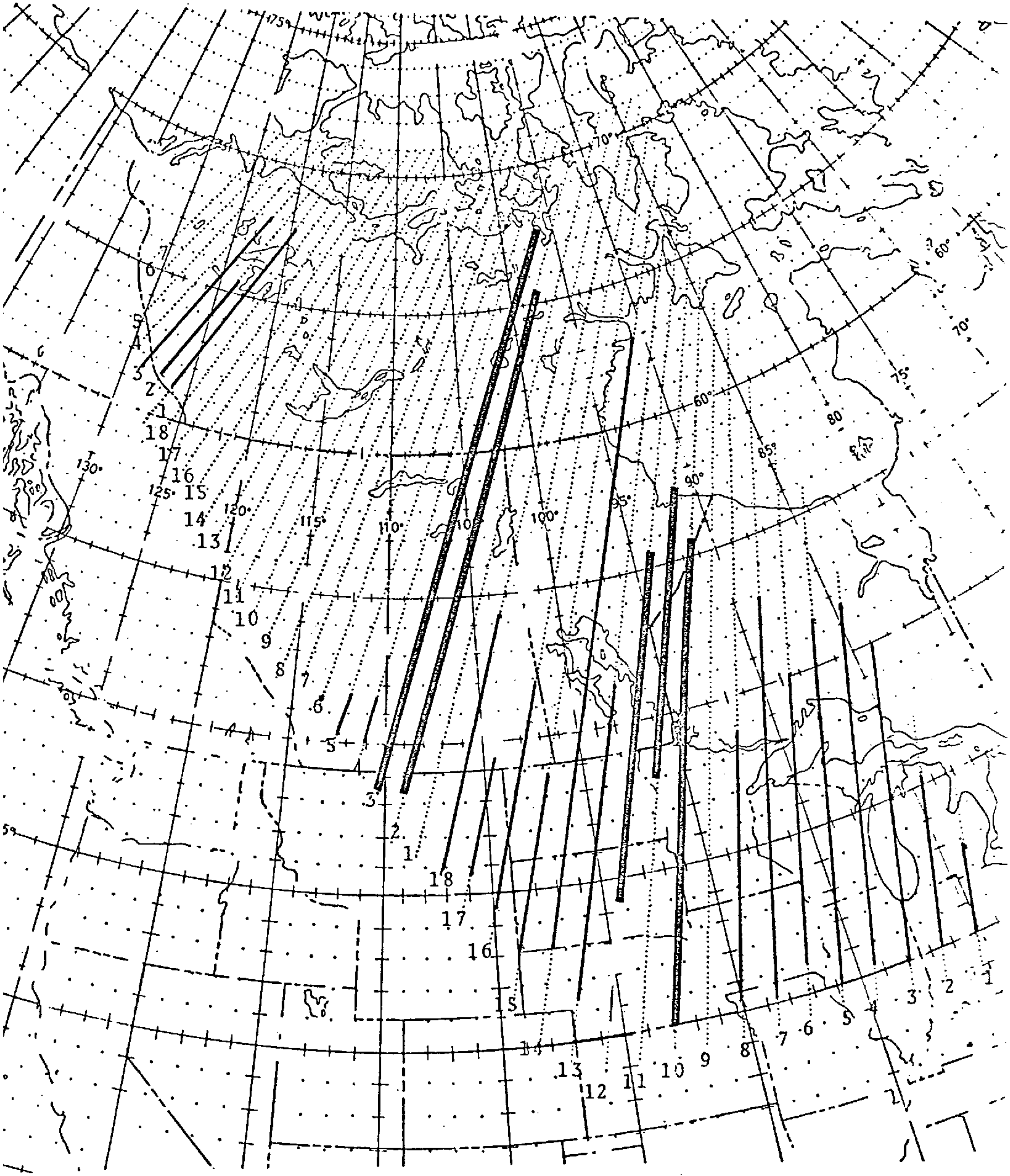
ERTS 1 GROUND TRACKS

CYCLE 4 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE SEP	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



ERTS 1 GROUND TRACKS

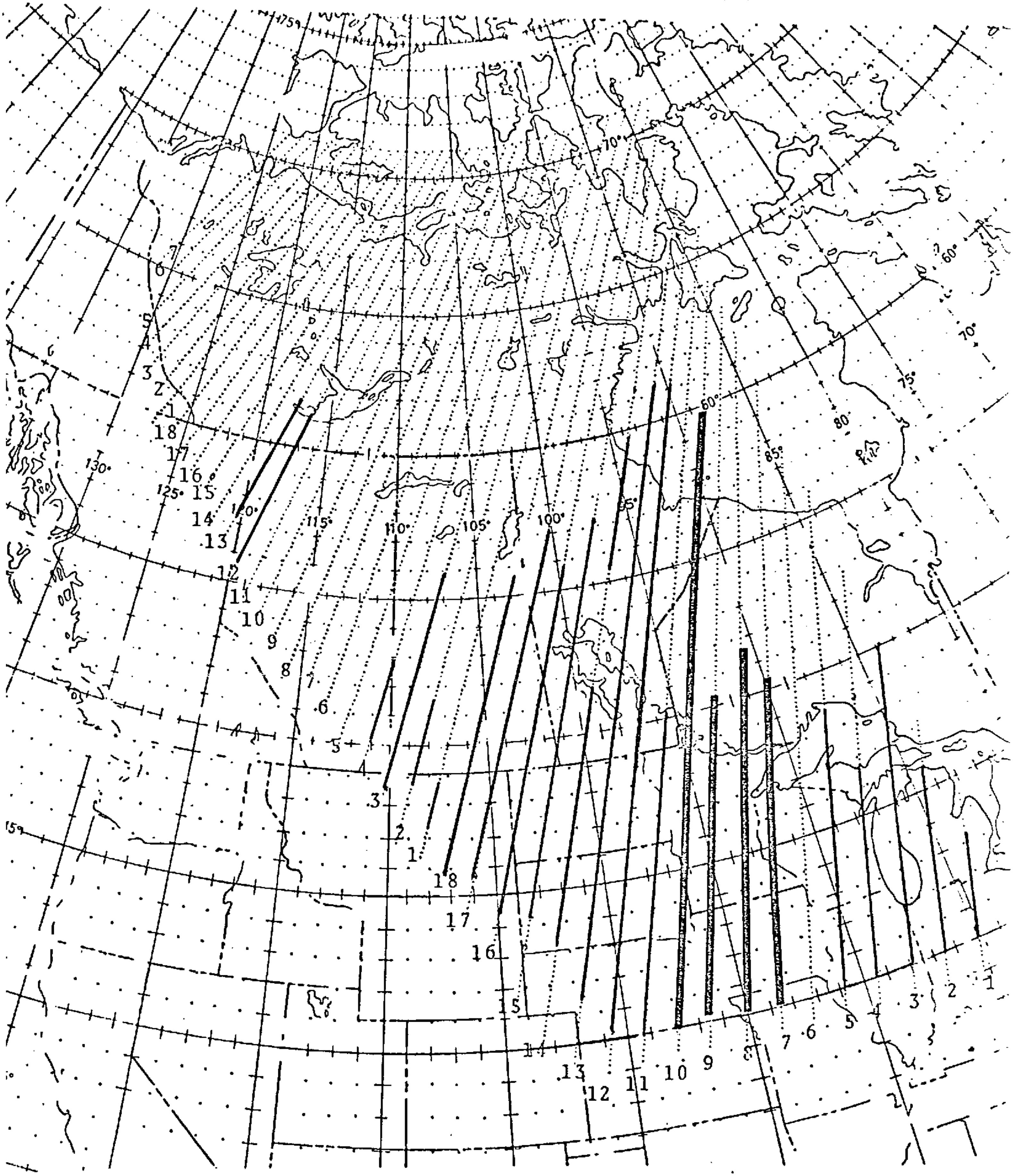
CYCLE 5 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE OCT	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3



C-14

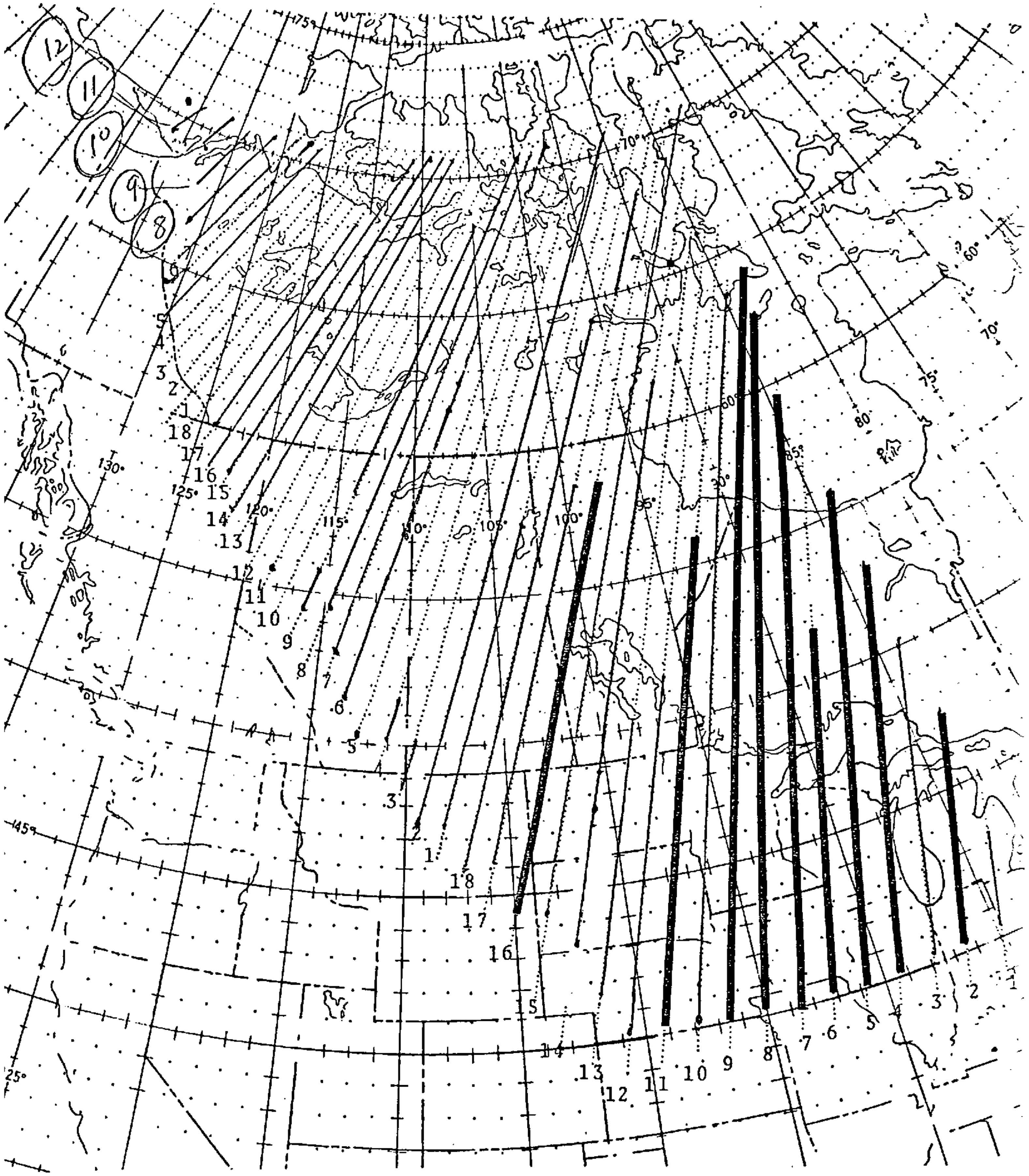
ERTS 1 GROUND TRACKS

CYCLE 6 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE NOV	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21



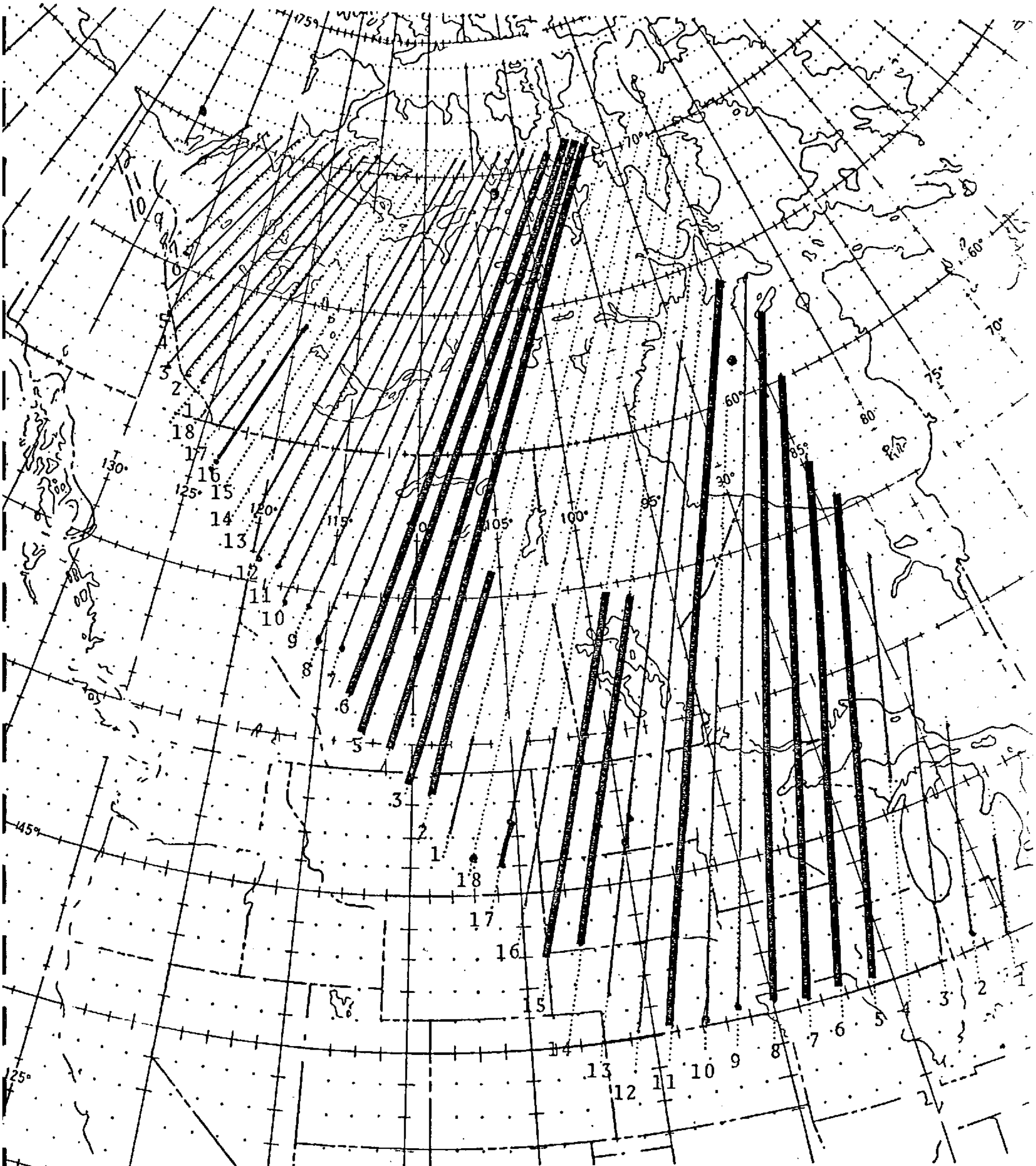
ERTS 1 GROUND TRACKS

CYCLE 7 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE NOV	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9



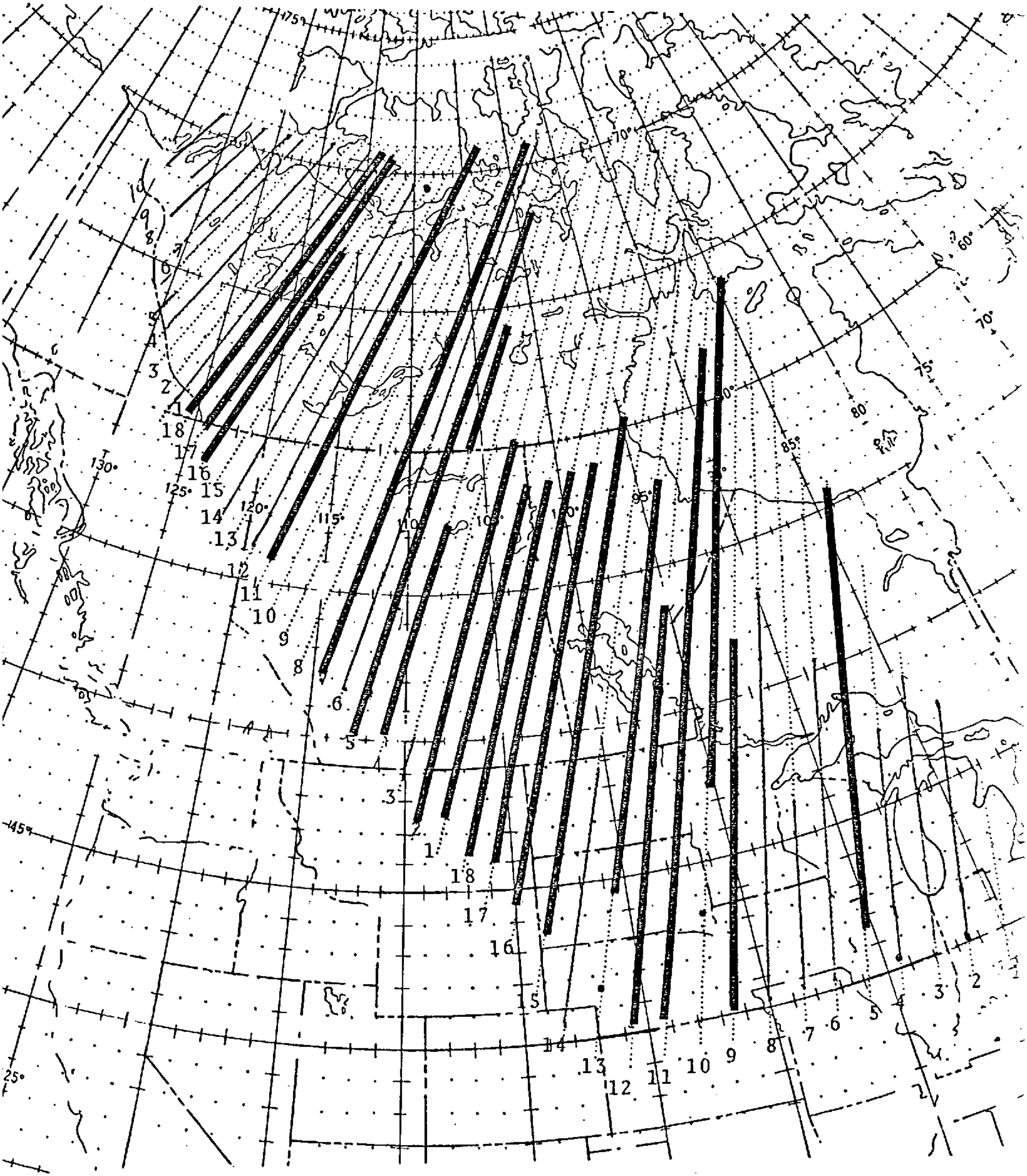
ERTS 1 GROUND TRACKS

CYCLE 13 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE MAR	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27



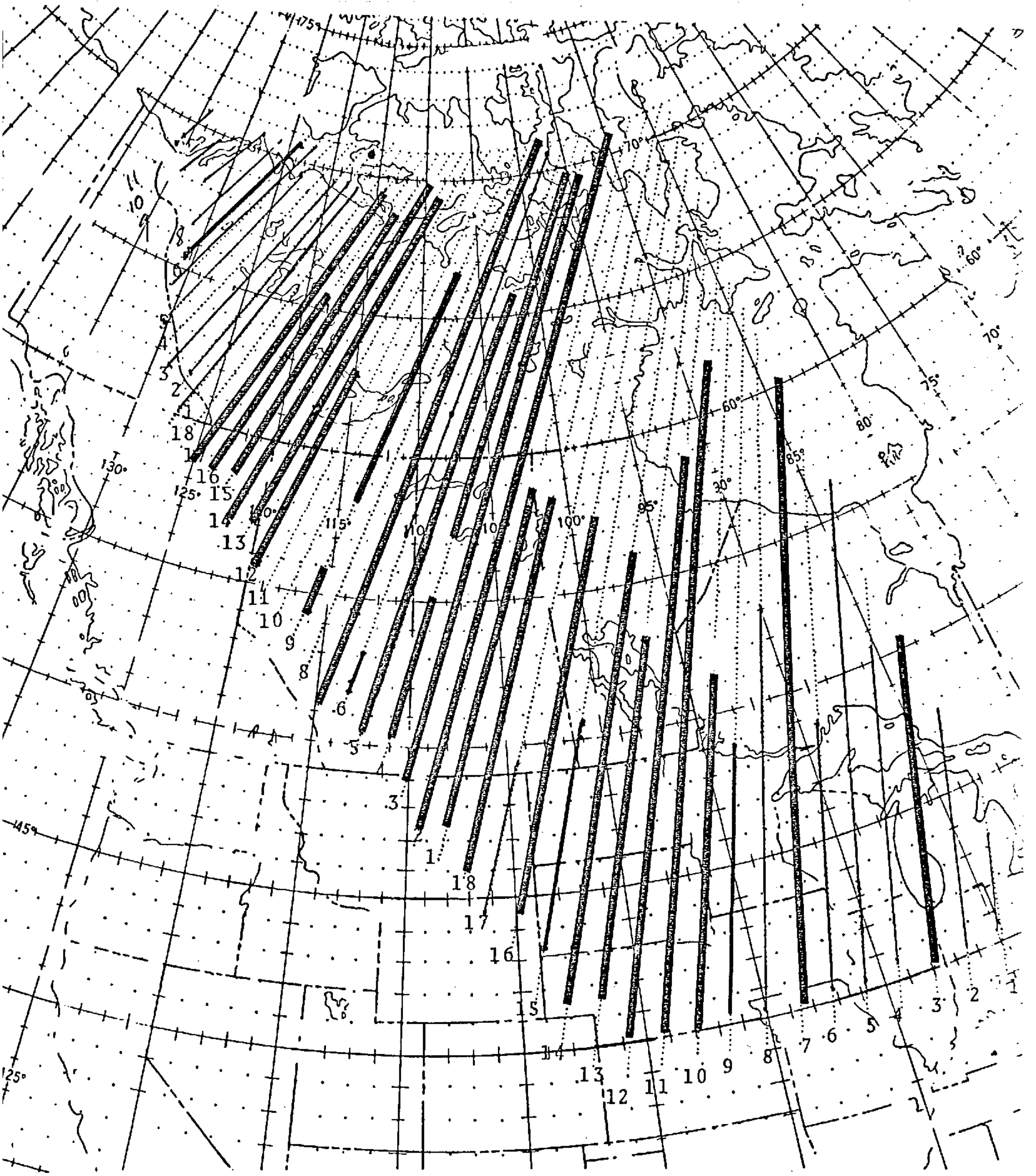
ERTS 1 GROUND TRACKS

CYCLE 14 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE MAR	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14



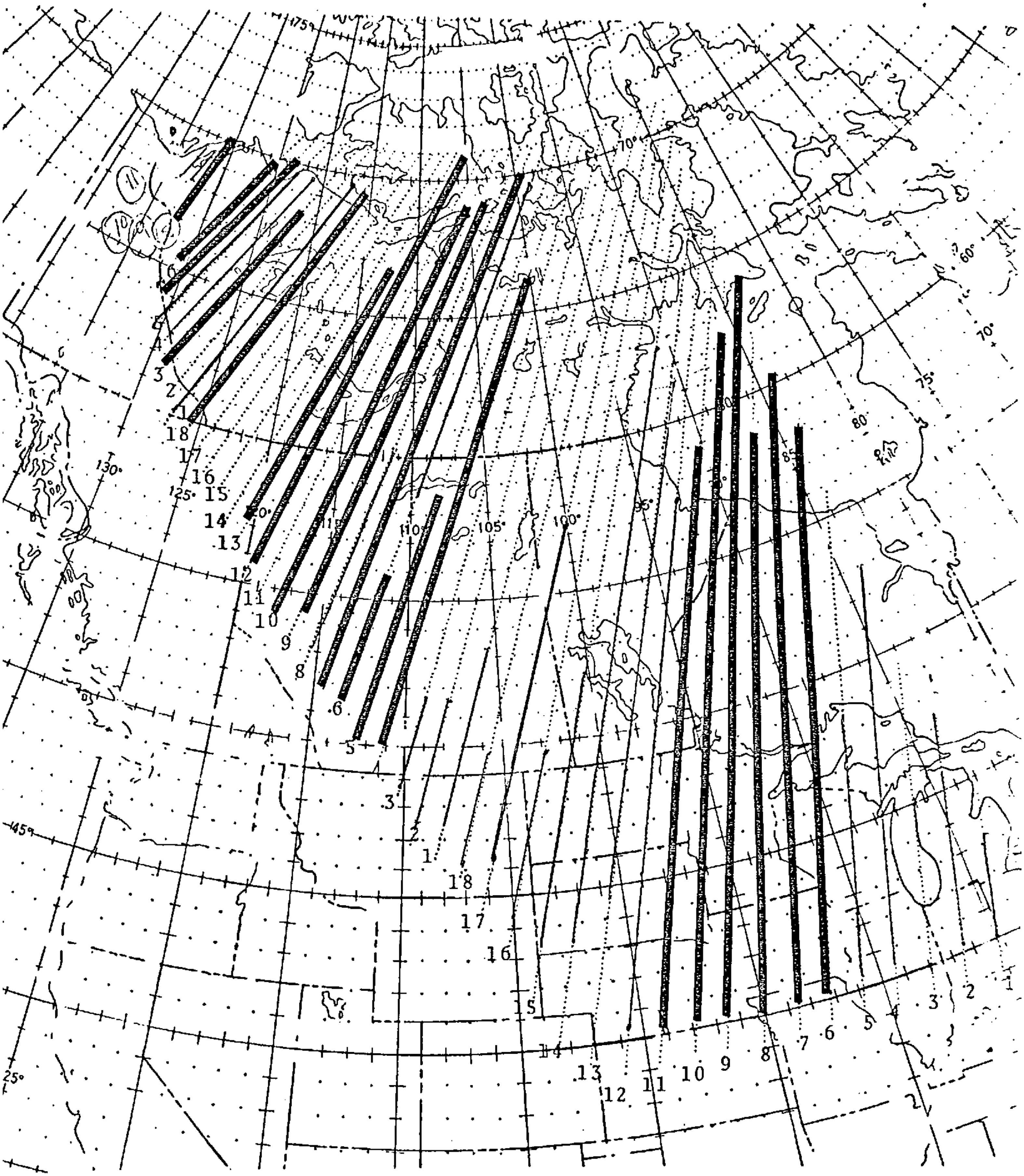
ERTS 1 GROUND TRACKS

CYCLE 15 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE APR	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2



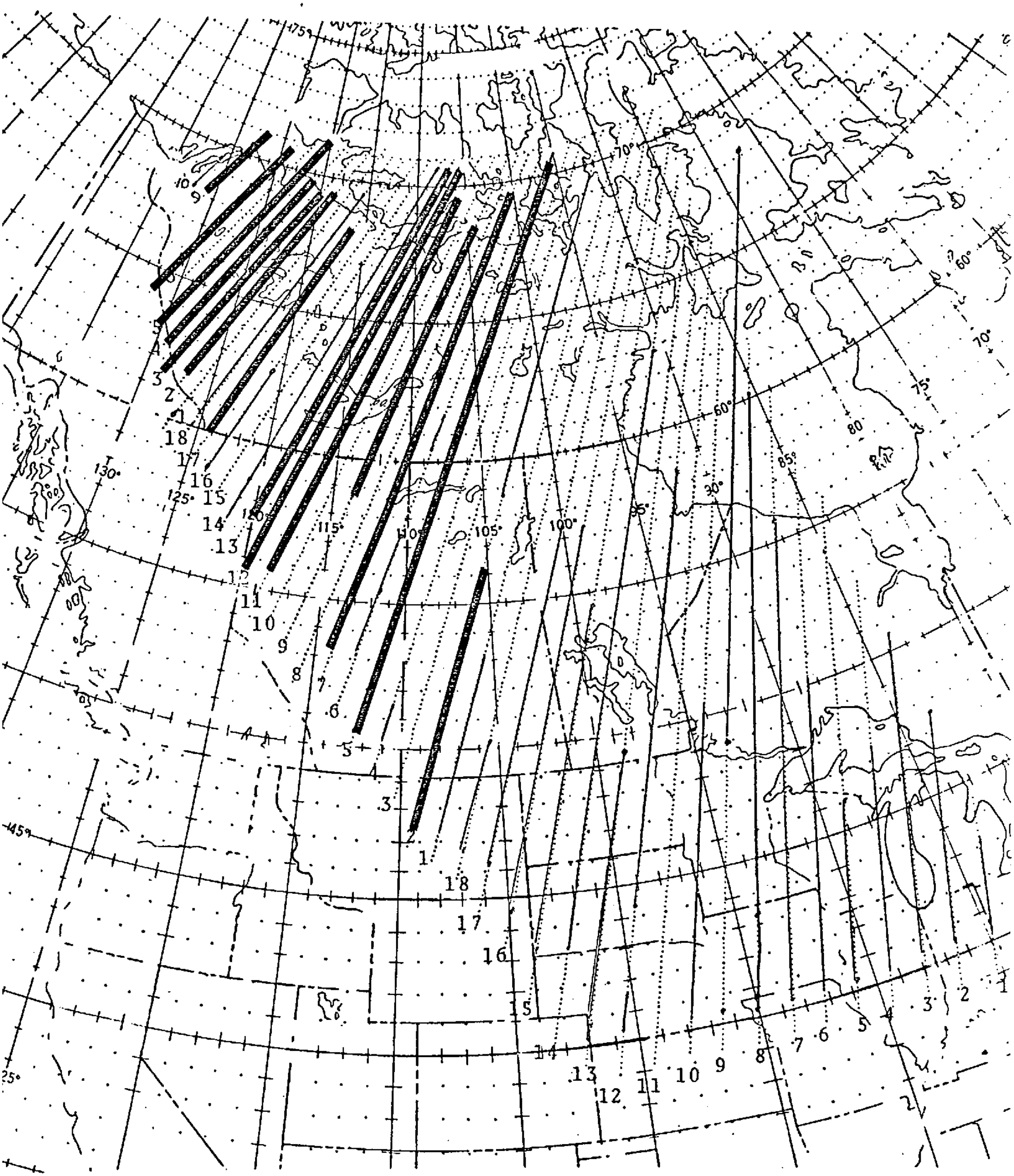
ERTS 1 GROUND TRACKS

CYCLE 16 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE MAY	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20



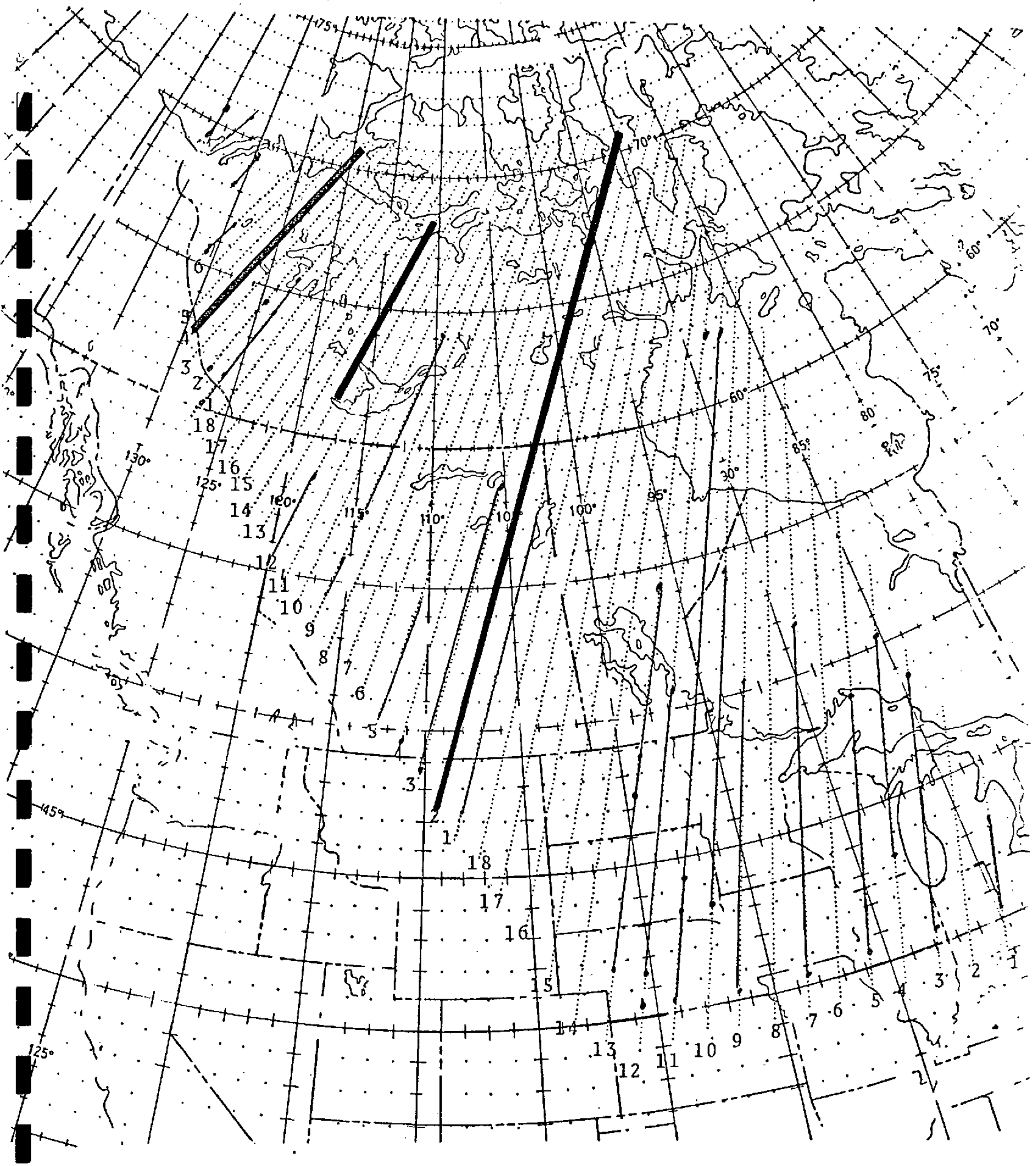
ERTS 1 GROUND TRACKS

CYCLE 17 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE MAY	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7



ERTS 1 GROUND TRACKS

CYCLE 18 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE JUNE	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25



ERTS 1 GROUND TRACKS

CYCLE 19 DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DATE JUNE	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13